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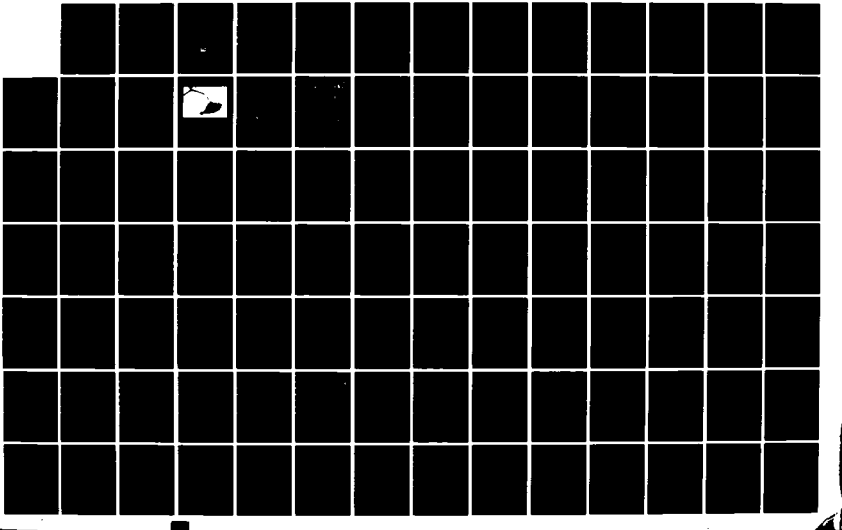

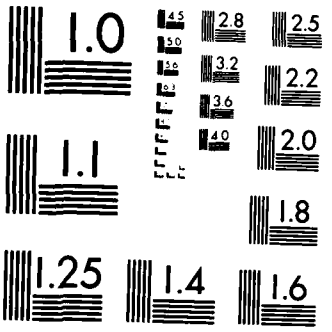

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CONNECTICUT RIVER BASIN
TOWN OF LONDONDERRY
WINDHAM COUNTY, VERMONT

GALE MEADOWS DAM
VT 00115
GALE MEADOWS DIKE
VT 00274

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MA 02154

MARCH 1980

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Town of Londonderry
Windham County, VT.
Mill Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earth embankment about 300 ft. long and 30 ft. high. The dike is an earth embankment about 150 ft. long and 6 ft. high. TCe dam is in fair condition. There are a few concerns though. The dam is intermediate in size with a significant hazard potential. There are various remedial measures and recommendations which should be undertaken by the owner.

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CONNECTICUT RIVER BASIN
TOWN OF LONDONDERRY
WINDHAM COUNTY, VERMONT

GALE MEADOWS DAM
VT 00115

GALE MEADOWS DIKE
VT 00274

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

GORDON E. AINSWORTH & ASSOCIATES, INC.
Engineers, Surveyors and Planners
20 SUGARLOAF ST. SOUTH DEERFIELD, MASS. 01373

PROJECT NO. 21.06.79109

LETTER OF TRANSMITTAL

FROM THE CORPS OF ENGINEERS TO THE STATE

TO BE SUPPLIED BY THE CORPS OF ENGINEERS

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.: VT 00115, VT 00274

Name of Dam: Gale Meadows Dam, Gale Meadows Dike

Town: Londonderry (Dike in Town of Winhall)

County and State: Windham County, Vermont (Dike in Bennington Co.)

Stream: Mill Brook

Date of Inspection: 19 November 1979

BRIEF ASSESSMENT

1. Project Description

Gale Meadows Dam is owned by the Vermont Fish and Game Department to create a public fishing impoundment. The dam is an earth embankment about 300 feet long by about 30 feet high. Included in the length of the dam is an emergency overflow spillway at the left abutment having a trapezoidal opening about 170 feet long on top. Top width is about 25 feet, with upstream and downstream slopes of about 3H:1V.

Normal pool elevation is maintained at about 7 feet below the top of the dam by a drop inlet service spillway with an outlet conduit running through the embankment and discharging to a brook at the downstream toe. The emergency spillway weir crest is 5 feet below the top of the dam and 2 feet above the service spillway crest.

On a bay at the northeastern end of the pond, about 3/4 of a mile from the dam, there is a saddle dike. This dike is an earth embankment about 150 feet long by about 6 feet high. Top width is about 6 feet, with side slopes of about 2H:1V.

2. Significant Findings and Assessment

The dam is in FAIR condition. Problems include erosion of the riprap in the emergency spillway discharge channel; a seep at the right downstream abutment contact line; a seep at the right downstream side of the outlet conduit; brush on the slope and in the emergency spillway; and erosion in the zone of natural ground between the downstream toe and the emergency spillway discharge channel.

3. Hydraulic and Hydrologic Findings

The spillway is ADEQUATE to pass the test flood without overtopping the dam. In accordance with recommended guidelines of the Corps of Engineers, the dam is classified as INTERMEDIATE in size and as having a SIGNIFICANT hazard potential. Accordingly, a TEST FLOOD equal to ONE-HALF PMF (probable maximum flood) was judged as appropriate within the recommended range of one-half PMF to full PMF. The test flood does not overtop the dam, but results in a minimum freeboard of about 0.6 of a foot. Peak inflow for the test flood is 5720 cfs. Peak outflow is reduced by reservoir routing to 4410 cfs. Total project discharge capacity at the top of the dam is due to both the drop inlet service spillway and the emergency overflow spillway (drain port assumed closed) and is equal to 5800 cfs, or 120% of the test flood peak outflow.

4. Recommended Action

WITHIN ONE YEAR after their receipt of this Phase I Inspection Report, the Owner should implement the following recommendations:

a. Engage a registered engineer qualified in the design of dams to evaluate the design of stone protection or riprap on the emergency spillway discharge channel and make the necessary recommendations for repair.

b. Remove all brush from embankment slopes of the dam and dike, and clean all brush, trees, and logs from the emergency spillway.

c. Install piezometers and monitor water levels in the core and downstream shell.

d. Install weirs to monitor the seep at the right downstream abutment contact line and to the right of the outlet structure. Monitor quantity and turbidity semi-annually and evaluate the results as they are gathered.

Additional recommendations and remedial measures that should be implemented by the Owner WITHIN ONE YEAR after receipt of this Phase I Inspection Report are described in Section 7.

GORDON E. AINSWORTH & ASSOCIATES, INC.

Kenneth J. Male, P.E.

This Phase I Inspection Report on Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

THIS SHEET TO BE FURNISHED BY THE CORPS OF ENGINEERS

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external con-

ditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

GALE MEADOWS DAM AND DIKE

PHASE I INSPECTION REPORT

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6) Zoning - Central clay core, impervious shells (see Section 6.2). None

7) Impervious Core - Clay core 5 feet wide at the top and 6 feet wide at the bottom of cutoff. None

8) Cutoff - 5 foot deep by 10-foot wide cutoff into foundation material which is glacial till. None

9) Grout Curtain - None. None

10) Other - Spillway cut in earth at left abutment. None

h. Diversion and Regulating Tunnel - N/A

i. Spillways

1) Service Spillway

a) Type - Rectangular drop inlet with stop planks on upstream side.

b) Length of Weir - Two 3.75 foot weirs (with stop planks) and two 9.75 foot weirs, 27 feet total effective length.

c) Crest Elevation - w/o stop planks 1354
- w/stop planks 1358

d) Gates - None.

e) Upstream Channel - Not applicable, reservoir all around.

f) Downstream Channel - Spillway discharges into vertical concrete transition 20 feet deep, then through dam via reinforced concrete spillway outlet conduit 180 feet long and 5 feet in diameter. Upstream invert EL 1338, downstream invert EL 1335, and discharging into Mill Brook at toe of dam.

g) General - No Comment.

d.	Reservoir (length in feet)	
	1) Normal Pool	4400 ±
	2) Flood Control Pool	N/A
	3) Spillway Crest Pool (drop inlet)	4400 ±
	4) Top of Dam	4500 ±
	5) Test Flood Pool	4480 ±
e.	Storage (acre-feet)	
	1) Normal Pool	1338
	2) Flood Control Pool	N/A
	3) Spillway Crest Pool (drop inlet)	1338
	4) Top of Dam	2942
	5) Test Flood Pool	2786
f.	Reservoir Surface (acres)	
	1) Normal Pool	204
	2) Flood Control Pool	N/A
	3) Spillway Crest Pool (drop inlet)	204
	4) Top of Dam	261
	5) Test Flood Pool	256
g.	Dam	Dike
	1) Type - Earth.	Earth
	2) Length - 300 feet including emergency spillway.	150 feet
	3) Height - Hydraulic Height - 30 feet.	6 feet
	- Structural Height - 33 feet.	6 feet
	4) Top Width - 25 feet.	6 feet
	5) Side Slopes - Upstream - 3H:1V.	2H:1V
	- Downstream - 3H:1V.	2H:1V
	a) Approximate Volume - 13,000 cu. yd.	600 cu. yd.

3) Ungated spillway capacity at top of dam:
   a) Drop inlet service spillway, 540 cfs @ EL 1365
   b) Emergency overflow spillway, 4760 cfs @ EL 1365

4) Ungated spillway capacity at test flood pool:
   a) Drop inlet service spillway, 530 cfs @ EL 1364.4
   b) Emergency overflow spillway, 3880 cfs @ EL 1364.4.

5) Gated spillway capacity at normal pool - N/A.

6) Gated spillway capacity at test flood pool - N/A.

7) Total spillway capacity at test flood pool, 4410 cfs @ EL 1364.4.

8) Total project discharge at top of dam, 5300 cfs @ EL 1365.

9) Total project discharge at test flood pool, 4410 cfs @ EL 1364.4.

c. Elevation (feet - NGVD)

All elevations are from design drawings of the dam by Haley and Ward Engineers, Inc., dated December 1964 (included as Appendices B2-1 to B2-5) and are assumed to be in feet above mean sea level NGVD (National Geodetic Vertical Datum of 1929).

1)	Natural Stream bed at Toe of Dam - Downstream	1335
	- Upstream	1338
2)	Bottom of Cutoff (same as bottom of core wall)	1332
	a) Lowest Foundation Surface (bottom of cutoff)	1332
	b) Core Wall - Bottom	1332
	- Top	1362
3)	Maximum Tailwater	Unknown
4)	Normal Pool	1358+
5)	Full Flood Control Pool	N/A
6)	Spillway Crest (ungated)	
	- Drop inlet service spillway	1358
	- Emergency overflow spillway	1360
7)	Design Surcharge	Unknown
8)	Top of Dam and Dike	1365
9)	Test Flood Surcharge	1364.4

from the Vermont Fish and Game Department. The construction contractor for the repair work was Sailor Brothers, Inc., whose address is unknown.

No other construction, modification, or major repair are known to have occurred. Refer to Section 2 of this report for a complete discussion of the design, construction, and operation history, with selected plans and other engineering data included in Appendix B.

1 i. Normal Operation Procedures

There are no written operation and maintenance procedures for the dam. The dam site is visited periodically, but this is mainly for maintenance to the recreational area at the dam site.

Reportedly the outlet works are not operated during the year. At the present time the service spillway crest is set at EL 1358 (stop planks in upstream weir are in-place) and the slide gate on the drain port is closed.

Refer to Section 4 of this report for a complete discussion of operation and maintenance procedures.

1.3 Pertinent Data

a. Drainage Area

1) Location - South-central Vermont in the Green Mountains.

2) River Basin - Mill Brook to Winhall River, then to West River, then to Connecticut River.

3) Shape - Roughly rectangular, 5 miles by 2 miles.

4) Area - 9.98 square miles, or 6385 acres.

5) Topography - Wooded slopes varying from 2% to 20% slope. Elevations vary from EL 1358 to EL 3260.

5 b. Discharge at Dam Site (cfs)

1) Outlet Works
Drain port, 2 feet by 2 feet, invert at EL 1338, gate normally closed, discharge capacity about 98 cfs at top of dam EL 1365.

2) Maximum Known Flood - Unknown.

bend just upstream of the structures. Total economic loss is judged appreciable. Loss of a few lives is judged possible. The dam failure analysis is developed in Section 5.5 of this report.

e. Ownership

Since its construction, the dam and pond have been and are still owned by:

Vermont Fish and Game Department
Agency of Environmental Conservation
79 River Street - State Office Building
Montpelier, Vermont 05602

Attention: Edward F. Kehoe, Commissioner
(802) 828-3371

It is not known how much of the watershed, if any, is owned by the State of Vermont.

f. Operator

No one is specifically responsible for the day to day operation of the dam. However, the Owner's representative and contact is:

John Guilmette, Facilities Engineer
Agency of Environmental Conservation
Department of Water Resources & Environmental Engineering
State Office Building
Montpelier, Vermont 05602

(802) 828-3361

g. Purpose of Dam

The dam was originally constructed for the Vermont Fish and Game Department to impound water for a public fishing impoundment. Gale Meadows Pond is still used for this purpose.

h. Design and Construction History

The dam was constructed in 1965 for the Vermont Fish and Game Department. The designer was Haley and Ward Engineers, Inc., 25 Fox Road, Waltham, Massachusetts 02154, telephone (617) 890-3980. Data obtained from the designer can be found in Appendices B2 and B3. The construction contractor for the original construction is not known.

Inspection reports as early as 1972 note erosion damage to the discharge channel of the emergency spillway which became progressively worse. In October of 1977 the spillway discharge channel was repaired under the direction of an engineer

service bridge with the upstream slope of the dam toward the left side of the embankment. A vertical concrete transition drops 20 feet into a closed 5-foot diameter concrete outlet conduit about 180 feet long through the dam which discharges into Mill Brook.

The upstream side of the drop inlet spillway weir can be lowered about 4 feet by removing the stop planks which are normally left in place. This lowers the weir crest to EL 1354 and reduces the total weir length to about 7.5 feet. The entire service spillway weir is protected from debris by a trash rack. On the upstream side of the control structure is a 2 foot square drain port at EL 1338. The drain port, normally closed, is regulated by a slide gate with an operating nut in a valve box set flush in the top of the control structure.

The emergency overflow spillway consists of an ungated, excavated earth channel along the left abutment of the dam with a concrete weir control crest, at EL 1360, having a trapezoidal opening 120 feet wide at the bottom and about 170 feet wide on top. The spillway channel is grassed and sloped upward from the pond toward the weir section. The downstream channel is rock riprapped and narrows at the toe of the dam where it discharges into Mill Brook.

2) Dike

On a bay at the northeastern end of the pond there is a saddle dike. This dike is a compacted earth embankment about 150 feet long by about 6 feet high. The dike has side slopes of about 2H:1V and a top width of 6 feet. The side slopes are covered with grass, brush, and small trees.

c. Size Classification

In accordance with recommended guidelines (Reference 1), Gale Meadows Dam is classified as INTERMEDIATE in size because its maximum storage capacity at top of dam is 2942 acre-feet (within the 1000 to 50,000 acre-foot range). The maximum hydraulic height of the dam is 30 feet.

d. Hazard Classification

In accordance with recommended guidelines (References 1 and 18) involving loss of life and economic loss, Gale Meadows Dam is classified as having a SIGNIFICANT hazard potential. The dam is located in a predominantly rural or agricultural area. However, the increase in flow due to a dam failure would increase damage to a Town highway bridge and the road on either side, damage a portion of State Route 100, and damage or destroy one house and barn and a house trailer next to State Route 100 due to the large flow of water at about 22 fps going out-of-channel at a stream

3.37 County about 2 miles northwest of the community of Rawsonville. The dam at its maximum section is at Latitude 43 degrees - 10.1 minutes North, Longitude 72 degrees - 51.8 minutes West. There is also a saddle dike on the impoundment located at Latitude 43 degrees - 10.6 minutes North, Longitude 72 degrees - 52.0 minutes West. The dike and most of the impoundment are in the Town of Winhall, Bennington County.

Access to the dam is from State Route 30 to the south at Bondville and then via a Town road (see Drainage Area Map, Appendix D-1).

The popular name of the dam is the same as its official name, Gale Meadows Dam. The name of the impoundment is Gale Meadows Pond. The pond is aligned along a north - south axis with the dam located on a bay of the pond at the southeastern end. The dike is located on a bay at the northeastern end of the pond.

The dam is built across Mill Brook, a tributary of the Winhall River. About 8500 feet downstream from the dam, Mill Brook runs near a house and barn and a house trailer and then passes under Vermont State Route 100. The nearest downstream community is Rawsonville, population estimated at 50, located about 2 miles downstream from the dam near the confluence of Mill Brook and the Winhall River. Rawsonville is not an incorporated village, but is simply a grouping of some houses and other structures in the Township of Jamaica, Windham County.

b. Description of Dam and Appurtenances

1) Dam

Gale Meadows Dam is a rolled and compacted earth embankment composed of glacial till with a clay core. The dam has a drop inlet service spillway and an emergency overflow spillway with a concrete weir crest at the left abutment of the dam. The grass and brush-covered embankment is about 300 feet long (including the emergency spillway) by about 30 feet high. The upstream and downstream slopes are about 3H:1V. The upstream slope of the dam is covered with rock riprap at the normal water surface, EL 1358. The top width of the dam is about 25 feet.

The dam has a clay core about 5 feet wide at the top and 6 feet wide at the bottom of the cutoff. The cutoff is compacted earth fill around the bottom of the clay core. The cutoff trench is 5 feet deep by 10 feet wide into the dam foundation, which is glacial till.

The drop inlet service spillway consists of a straight weir crest, at EL 1358, on 4 sides of a rectangular concrete spillway structure (27 feet total effective crest length) located about 50 feet upstream of and connected via a

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

NAME OF DAM: GALE MEADOWS DAM, ID NO. VT 00115

GALE MEADOWS DIKE, ID NO. VT 00274

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act, Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Gordon E. Ainsworth and Associates, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed was issued to Gordon E. Ainsworth and Associates, Inc., under a letter from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0012 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public, and thus permit correction in a timely manner by non-Federal interests.

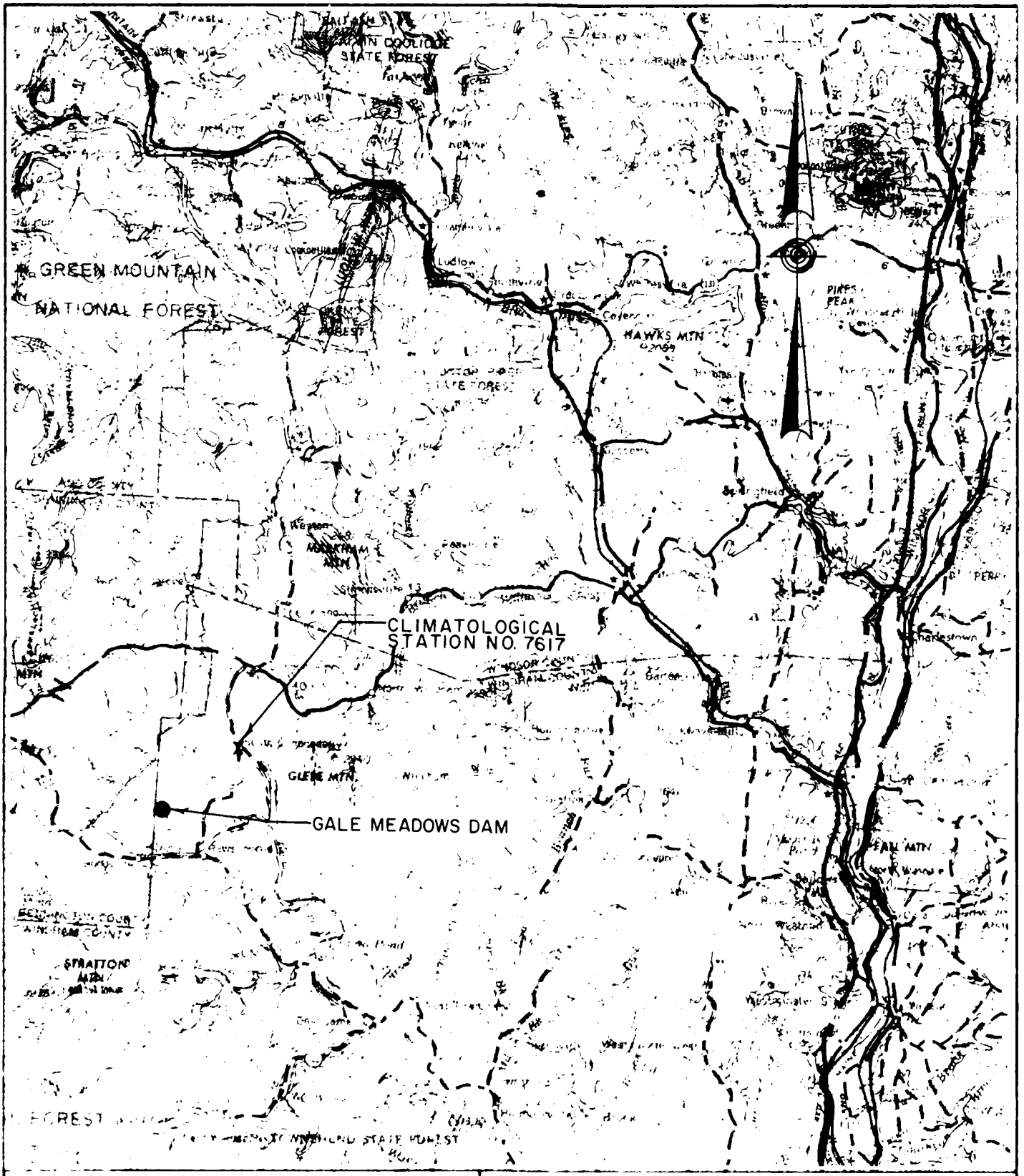
2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

3) To update, verify, and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Referring to the Location and Vicinity Maps at the beginning of this report, Gale Meadows Dam is located in south-central Vermont, just inside the Town of Londonderry, Windham



APPROX. SCALE IN MILES

0 2 4 8 12

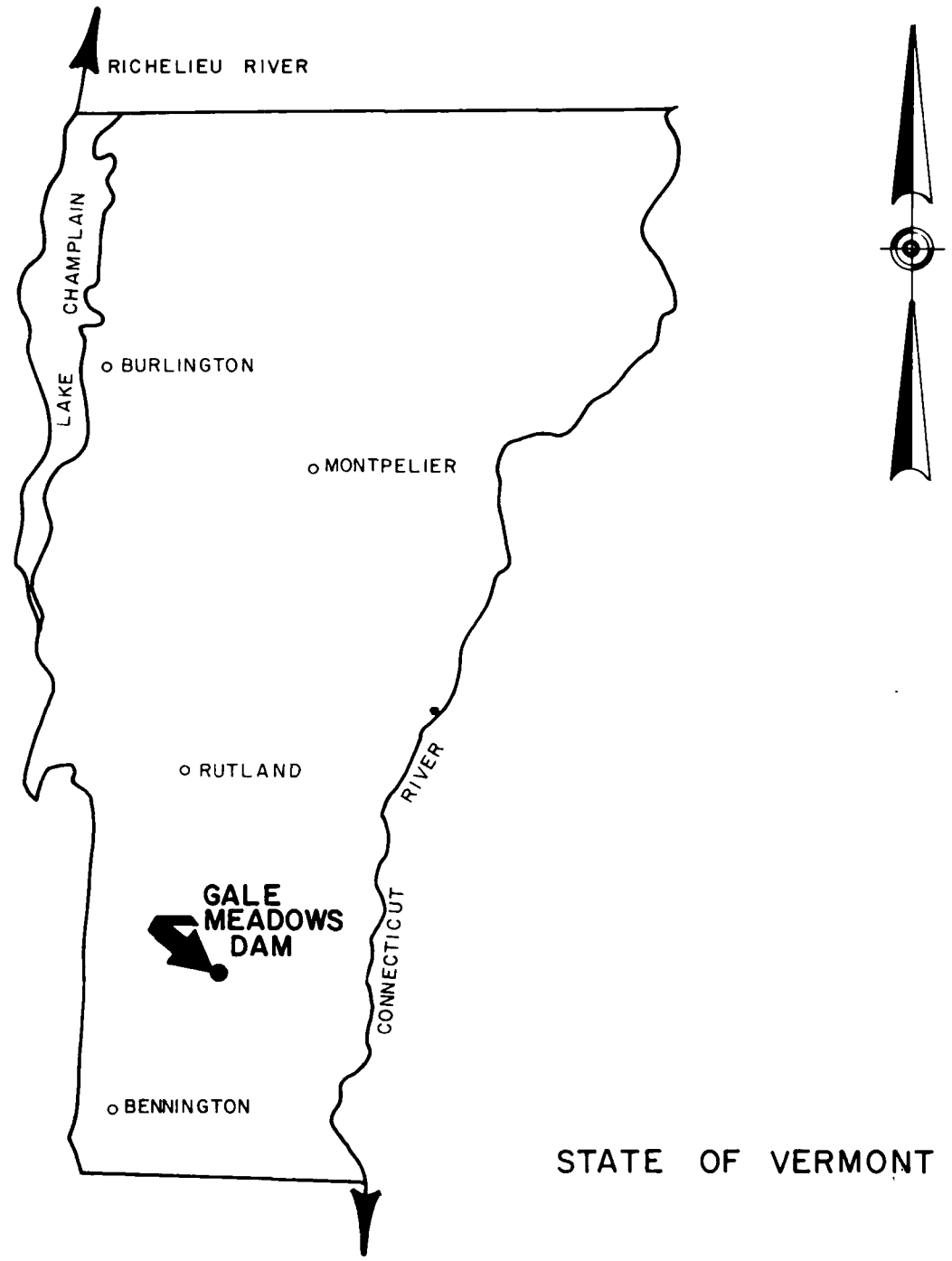
DATUM - NGVD 1929, 100' CONTOUR INTERVAL

BASE MAP - 1 250,000 USGS TOPO MAP
GLENS FALLS, N.Y., VT., NH.,
1956, LIMITED REVISION 1967

GALE MEADOWS DAM
VICINITY MAP

GORDON E AINSWORTH & ASSOCIATES INC

20 SUGARLOAF ST SOUTH DEERFIELD MASS 01373



APPROX. SCALE IN MILES
0 25 50 75

GALE MEADOWS DAM
LOCATION MAP

GORDON E. AINSWORTH & ASSOCIATES INC.
Engineers Surveyors and Planners
20 SUGARLOAF ST SOUTH DEERFIELD MASS 01373

Overview Photo - Gale Meadows Dam - 11/30/79

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3 - VISUAL INSPECTION

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2) Emergency Spillway

a) Type - Broad-crested free overflow with a concrete weir control section having a trapezoidal opening about 170 feet long at top of dam.

b) Length of Weir - 120 feet.

c) Crest Elevation - w/o flashboards 1360
- with flashboards N/A

d) Gates - None.

e) Upstream Channel - Grassed approach section 15 feet long sloping up toward spillway weir.

f) Downstream Channel - About a 230-foot long channel founded on a glacial till curving down left abutment and narrowing as it discharges into Mill Brook. Channel bottom and side slopes are paved with rock riprap.

g) General - No Comment.

j. Regulating Outlets

1) Drain Port

a) Invert - EL 1338.

b) Size - 2-foot by 2-foot square.

c) Description - Square port in bottom of upstream wall of control structure discharging into spillway outlet conduit.

d) Control Mechanism - Sluice gate with operating nut on top of control structure.

e) Other - No Comment.

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SECTION 2

ENGINEERING DATA

2.1 Design Data

The dam was designed between 1962 and 1964 by Haley and Ward Engineers, Inc., 25 Fox Road, Waltham, Massachusetts 02154, telephone (617) 890-3980.

The dam and reservoir were part of the design for an entire fishing recreational area, which also included access roads to the site. The Owner has a complete set of prints of the design/construction drawings. Sheets pertinent to the dam and dike are reproduced at reduced scale in Appendix B2. Also included in Appendix B3 are some of the design calculations for the two spillways, as well as construction specifications.

2.2 Construction Data

a. Initial Construction

The dam and dike were constructed in 1965. The original contractor for the dam and dike is unknown. On Appendices B3-29 and B3-30 there are photographs of the reservoir, embankment, and outlet construction work performed in 1965. No other records of the actual construction of the dam and appurtenances are known.

b. Modifications

There are no records of any modifications to the dam.

c. Repairs and Maintenance

The only major repairs to the dam and appurtenances since its construction were the repair of the emergency spillway discharge channel and the replacement of the trash racks.

Inspection reports from November 1972 to June 1977 indicate erosion of the emergency spillway discharge channel (see reports starting on Appendix B3-32). In October, 1977 the erosion damage was repaired with rock riprap and the discharge channel was regraded. The repair work was supervised by the Vermont Fish and Game Department. The construction contractor for the repair work was Sailor Brothers, Inc., whose address is unknown.

3672 An inspection report on July 13, 1977 (see Appendix B3-39) indicated that the trash rack of the outlet structure was in extremely poor condition. In October 1977 construction details for new trash racks were prepared by the Vermont Fish and Game Department. It is believed that they were installed in 1978. It is not known who performed this repair work.

No other records of past repair and maintenance are known.

d. Pending Remedial Work

The Owner has no plans for any pending remedial work.

2.3 Operation Data

a. Inspections

Several inspection reports, including a Federal Disaster Assistance Administration Damage Survey report, were found, and all are included in Appendix B3. The first two inspection reports were by Donald H. Spies and are dated November 17, 1972 and September 29, 1975 (see Appendices B3-32 and B3-33). In these reports it is noted that seepage is occurring at the interface of the right abutment of the dam and the valley wall. Also, seepage was noted along the right wingwall of the outlet conduit from the service spillway. Both of these reports contain comments on erosion damage to the emergency spillway discharge channel. Also, heavy brush growth and debris is noted in the emergency spillway channel.

An inspection report dated August 23, 1976 by Donald H. Spies (see Appendices B3-34 to B3-35) contains more comments on continued erosion of the emergency spillway discharge channel. Brush growth and debris still clogged the emergency spillway discharge channel at this time and debris build-up around the service spillway weir was noted. Seepage at the right abutment was about the same, but seepage at the outlet conduit wingwall had stopped. Seepage was also noted from the eroded area between the service spillway outlet structure and the emergency spillway discharge channel.

The fourth inspection report (see Appendix B3-36) dated September 14, 1976, was a Federal Damage Survey Report. It described the erosion of the emergency spillway discharge channel and the cost for its repair. It also contained sketches of the eroded areas of the emergency spillway discharge channel (see Appendices B3-37 and B3-38).

6/32 The fifth inspection report, dated July 13, 1977, by Donald H. Spies (see Appendix B3-39) described the dam as "in the same condition as it was last fall, except that there did not appear to be any seepage through the bluff in the emergency spillway." Also in this report it was stated that the trash rack to the service spillway had been rendered useless and needed to be replaced.

The sixth inspection report on the dam, dated October 31, 1977, was also by Donald H. Spies (see Appendices B3-46 to B3-47) and concerns an inspection of repairs to the emergency spillway discharge channel. This report contains a discussion of the repair work as observed by a Vermont Fish and Game Department Engineer as well as the finished work as observed by Mr. Spies.

The seventh and last inspection report on the dam was by A. Peter Barranco, Jr., dated May 22, 1979 (see Appendices B3-48 to B3-56). In this report it was indicated that the dam was in good shape, except for some brush and tree growth on the slopes and in the emergency spillway discharge channel. It is also noted in the report that the only seepage from the dam was occurring near the downstream end of the service spillway outlet conduit.

b. Performance Observations

Other than the observations on seepage and erosion made in the various inspection reports (see Appendix B3), there are no other known records of performance observations. There is no instrumentation in the dam.

c. Water Levels and Discharges

There are no known records of routine water levels and discharges from the dam.

d. Past Floods

There are no known records of past floods at the dam.

e. Previous Failures

There are no known previous failures of the dam.

2.4 Evaluation

a. Availability

As listed on Appendix B1, various engineering data and records are available in the files of the Owner, the Designer, and of the Dam Safety Engineer of the Vermont Department of Water Resources. This data was reviewed, and copies of the records significant to the dam are included in chronological order in Appendices B2 and B3. Discussion of the data starts at the beginning of Section 2 of this report.

b. Adequacy

Available data consisted of the design/construction drawings, some design calculations, construction specifications, construction photographs, and seven inspection reports. Such data

as the complete design calculations, record drawings, data on the foundation and embankment soils, and operation and performance data were not available. The lack of such in-depth engineering data does not permit a comprehensive review. Therefore, the adequacy of this dam could not be assessed with respect to reviewing design, construction, and operation data.

c. Validity

Based on field observation and checking, the data available appears to be valid. The only discrepancy noted is in the length of the spillway outlet conduit. On one design/construction drawing (see Appendix B2-2) the length of the spillway outlet conduit scales about 180 feet. On another (see Appendix B2-3) the length of the conduit is dimensioned as 171.5 feet. The length of the conduit was not field checked due to the amount of water flowing in the conduit. However, 180 feet has been used as the length throughout this report.

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SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General

Gale Meadows Dam was inspected on November 19, 1979. The inspection party (see Appendix A-1) was accompanied by Mr. John Guilmette, Facilities Engineer, who represented the Owner. Also present was Mr. Peter Barranco, Jr., Dam Safety Engineer of the Vermont Department of Water Resources. The weather was sunny and the temperature varied between 45° F in the morning to 68° F at noon. The water surface was at elevation 1358.2, or about 0.2 of a foot over the service spillway crest. The Visual Inspection Checklist is included as Appendix A, while selected photos taken during the inspection are included in Appendix C. Appendix C-1 is a photo index map. The Overview Photo at the beginning of the report as well as several of the photos in Appendix C are aerial photos taken from a helicopter on November 30, 1979.

b. Dam and Dike

1) Dam

Photo C-2A shows the upstream face of the dam from the left side. Photo C-2B shows the same face from the right side. The emergency spillway through the left abutment is seen in the background. Substantial brush has grown up on the downstream side of the spillway weir.

The downstream slope is shown in Photo C-3A, which is taken from the right abutment near the toe. The emergency spillway channel passes behind the evergreen trees at the right in the photograph. A view of the crest from the left end is shown in Photo C-3B.

Seeps were observed near the downstream toe in two locations. Photo C-4A shows the right wingwall of the outlet structure. To the left of the wingwall in the photo, one can see seepage which has stained the dumped rock with a rusty-colored coating. On the day of inspection this seep was flowing clear water at about 10 gpm. The top of the seep was about 3.5 ft in elevation above the toeline. A close-up view of the flowing water is shown in Photo C-4B. This seep has been observed during past inspections. In one inspection report by D. H. Spies, August 19, 1976 (see Appendix B3-34), it was noted that this seep had ceased.

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At the downstream end of the right abutment contact line a second seep was observed, flowing clear at a rate of 3 to 5 gpm. The top of the seep was about 5 ft above the toeline. A

view of the seep looking upstream is shown in Photo C-5A. The bottom of the rule is at the top of the seep. This seep was mentioned in several previous inspection reports, starting in 1972. The elevation of the top of the seep has been as high as 10 ft above the toeline, according to these reports.

Significant erosion has occurred in the natural ground to the left of the outlet structure, i.e., between the outlet structure and the discharge channel of the emergency spillway. A view of this zone, looking upstream toward the right side of the dam, is shown in Photo C-5B. The downstream end of the spillway discharge channel is shown in the right foreground and the eroded natural ground is shown approximately in the center of Photo C-5B. Considerable evidence of past seepage from these steep eroded faces was evident. The root system is thoroughly undermined and is holding the surface in place. It may be noted from the photograph that downhill creep is occurring, since several trees are bowed near their trunks. In the inspection of August 19, 1976 by D. H. Spies (see Appendix B3-34), it was noted that seepage from these eroded "cliffs" was enough to keep the zone wet, but that there was no visible flow. This condition also existed during the present inspection.

There is some brush now growing on both slopes of the dam. Tree stumps up to 3-in. size were found on the downstream side. The brush on the upstream side is taking root in the riprap.

The riprap appears to be in good condition. There is minor evidence of wave-cutting at the reservoir shoreline.

2) Dike

Photo C-6A is an aerial overview of the saddle dike on the northeastern part of the reservoir. Photo C-6B shows the dike from a point just downstream from the right abutment. The dike is covered with brush and low trees on both slopes. Alders to 15-ft-high have taken root in the dumped rock on the upstream slope. The surface of the upstream slope is irregular on the scale of $\pm$ 1 ft, possibly due to frost action.

In Photo C-6B a wet zone is seen downstream from the dike. Based on the USGS topographic map that was prepared before the dike was built, it appears that this zone was swampy previously. On the day of inspection the head differential across the dike was about 2 ft.

31 The slopes of the dike were measured with a hand level and rule and found to be 2H:1V, rather than 3H:1V as shown on the design drawings (see Appendix B2-3).

c. Appurtenant Structures

1) Drop Inlet Service Spillway and Control Tower

The drop inlet service spillway (or intake structure) and control tower are one and the same concrete structure located upstream of the left side of the embankment portion of the dam (see Overview Photo). The service spillway is a rectangular concrete structure surrounded by water with weir crest and trash racks on all four sides (see Photos C-7A and C-7B). The inspection checklist for the service spillway (intake structure) is on Appendix A-4. The inspection checklist for the control tower is on Appendix A-5. Only the upper parts of the outside and inside of the service spillway and control tower were inspected. The lower parts of the structure were submerged.

From what was readily visible, the service spillway structure and its steel trash racks are in good to excellent condition. As seen in Photo C-7B, some small sticks had collected against the trash racks but were not causing any significant flow obstruction. There was some erosion of the concrete at the sides of the weirs and on the inside walls but it was of a minor nature. No cracks or leaks were observed in the service spillway and control tower structure.

On top of the control tower there is a 2-inch square operating nut in a valve box set flush with the concrete (visible at the upper right corner of Photo C-7B), which operates a slide gate over the drain port in the bottom upstream part of the control tower structure. The operation of this operating nut was not checked because a valve wrench was not available. The operating nut appeared to be in good, serviceable condition. At the time of inspection the drain port slide gate was fully closed.

The railing on top of the control tower was in excellent condition (see Photo C-7A).

2) Service Bridge

The service bridge is a wood-decked walkway supported on open web beams spanning about 50 feet from a point about 4 feet below the top of dam to a seat on the service spillway and control tower structure (see Photo C-7A). The inspection checklist is on Appendix A-9.

32 The concrete seats for the service bridge were in good condition as was the bridge structure itself. All of the wooden deck planking appeared solid and was in fair condition. The deck planking appeared to be bare wood and the steel portions of the bridge needed painting.

3) Outlet Transition and Conduit

The outlet transition and conduit consists of a 20 foot deep rectangular vertical concrete box section from the drop inlet weir crest with a 5-foot diameter concrete outlet conduit at the bottom. This conduit is about 180 feet long, passes through the dam, and discharges into Mill Brook at the downstream toe. According to the construction photographs on Appendix B3-29, there are anti-seepage collars along the length of this precast concrete conduit. The outlet conduit was not inspected, because of poor access and because of the amount and velocity of flow.

4) Outlet Structure

The outlet structure consists of a concrete headwall with wingwalls for the 5-foot diameter outlet conduit (see Photo C-8A). The inspection checklist is on Appendix A-7. The outlet structure was in good to excellent condition.

5) Emergency Spillway and Discharge Channel

The emergency overflow spillway is at the left abutment of the dam (see Overview Photo). The spillway consists of a grassed approach section from the pond, a trapezoidal control section with a concrete overflow weir, and a riprapped discharge channel. The inspection checklist is on Appendix A-8.

Photos C-2B and C-9A show the emergency spillway approach channel. The grassed approach channel is in good condition.

Photo C-9A shows the concrete overflow weir in the trapezoidal control section of the emergency spillway. The concrete weir is in good to excellent condition. It appears that the weir is bowed slightly downstream at the centerline near a construction joint. There are six small vertical cracks through the concrete weir section at various places with some minor efflorescence. The worst crack is 15 feet from the right at the junction of the level weir crest and sloped section (see Photo C-9B). There are also logs and debris hung up on the emergency spillway weir.

Just downstream of the spillway weir the discharge channel is covered with small trees and brush that are as much as 10 feet high (see Photo C-9A).

The emergency spillway discharge channel is shown in Photo C-10A. The discharge channel is covered with quarry-run stone riprap that ranges in size from peastone up to 2 ft (say about 600 to 800 lb). The major portion of this stone seems to be in the size range from 3 to 8 in.

A 3- to 4-ft-deep gully has been eroded in the channel at a point about 120 ft downstream from the weir, where the slope steepens. A view looking upstream at the gully is shown in Photo C-10B. A bar of the quarry-run stone has formed immediately downstream, as shown in Photo C-11A. Stones as large as 8 in. size apparently have been displaced by past discharges through the emergency spillway.

d. Reservoir Area

There does not appear to be excessive reservoir sedimentation. No potential landslide areas were noted around the reservoir. Also, there does not appear to be any potential hazard due to backwater flooding of the reservoir, even at the location of the dike. No features were observed that might cause excessive alteration of the drainage area or increased inflow.

e. Downstream Channel

The downstream channel is a continuation of Mill Brook starting from the outlet structure (see Overview Photo). From the outlet structure to where the brook joins the Winhall River, a distance of about 1.7 miles, Mill Brook is a somewhat rocky, sometimes steep channel that is heavily wooded along both sides. For a map of the downstream channel, refer to the Drainage Area Map, Appendix D-1, which also indexes photos that cover the downstream area. Photo C-11B is an aerial overview of the reservoir and dam looking downstream.

About 0.2 miles downstream from the dam (Sta. 10+00) Mill Brook passes under a wood-decked bridge that is part of an unpaved Town road (see Photo C-12A).

About 1.6 miles downstream (Sta 85+00) the brook passes by a house and barn and a house trailer which are close to the stream (see Photos C-13A and C-13B). There is a ponding area in the stream at this point created by a small dam (see Photo C-12B). Just downstream of Sta 85+00 the brook passes under an abandoned bridge and then under a bridge for Vermont State Route 100 (formerly State Route 8).

3.2 Evaluation

The seeps that were observed during this inspection and past inspections to the right of the outlet structure and at the downstream right abutment contact line apparently vary in volume with time. There is no current evidence that these seeps are becoming more or less severe, nor is there any evidence that soil fines are being displaced. It is possible that the seep near the outlet structure is due to leakage along the channel that was cut in the right abutment for the conduit. The seep at the contact line may be due to flow through the abutment. These seeps should be monitored quantitatively so that a record of their behavior is obtained.

The brush and trees on the dam and dike should be cut and removed annually.

The stone that covers the emergency spillway discharge channel, particularly in the zone where the slope steepens, apparently are too small to resist high flows. This channel-covering material should be evaluated to determine whether larger sizes are necessary.

The eroded banks in the natural ground between the downstream toe and the downstream end of the emergency spillway discharge channel should be cleared, shaped, and protected against erosion.

The debris on the emergency spillway weir should be removed. Also, the brush and small trees in the discharge channel just downstream of the weir should be cut and removed.

The six vertical cracks in the concrete spillway weir are minor and do not threaten the integrity of the weir. However, the cracks should be checked periodically for possible worsening condition.

The steel portions of the service bridge should be painted to prevent deterioration.

The slide gate on the drain port was not operated because a valve wrench was not available. Its operating condition should be checked.

The outlet conduit and the inside of the drop inlet were not thoroughly inspected because of the amount of flowing water. They should be dewatered to ascertain their condition as well.

SECTION 4

OPERATION AND MAINTENANCE PROCEDURES

4.1 Operation Procedures

a. General

Gale Meadows Pond is used as a public fishing impoundment. The water level in the pond is apparently allowed to vary, because no attempt is made to control outflow during the year. At the time of the inspection the pond level was about 0.2 of a foot higher than the service spillway crest. The drain port in the control structure was closed and the stop planks in the upstream portion of the service spillway weir were in place.

The emergency spillway is ungated and wide open. Reportedly the emergency spillway operates during periods of high runoff.

There are no written operation procedures for the dam and pond.

b. Emergency Action Plan and Warning System

There is no emergency action plan and warning system in effect for Gale Meadows Dam.

4.2 Maintenance Procedures

a. General

According to the Owner maintenance personnel visit the site periodically, but these visits are mainly to maintain the recreational facilities at the dam. It appears from our inspection that trees and brush have not been cleared from portions of the emergency spillway, from parts of the dam, and from the saddle dike in the recent past. No written maintenance procedures exist for the dam and pond and their operating facilities.

b. Operating Facilities

(Covered under preceding Section 4.2.a - General.)

4.3 Evaluation

Written operation and maintenance procedures for this dam do not exist. Although there have been repairs in the past (e.g., repair of erosion in emergency spillway discharge channel and replacement of trash racks), our visual inspection suggests that brush clearing, for instance, has been rather irregular and less often

than yearly. Brush and small trees were evident in the emergency spillway discharge channel just downstream of the weir and on the slopes of the saddle dike. There was also some small brush on parts of both slopes of the dam. Effective operation and maintenance procedures need to be developed and implemented by the Owner in order to avoid deterioration of the dam.

A warning system with an emergency action plan needs to be developed by the Owner to ensure proper and timely action during critical periods.

SECTION 5

EVALUATION OF HYDRAULICS AND HYDROLOGY

5.1 General

Gale Meadows Dam is shown on the Location and Vicinity Maps at the beginning of this report and on the Drainage Area Map, Appendix D-1. The dam and pond are located on Mill Creek in south central Vermont. About 9000 feet downstream of the dam Mill Creek joins the Winhall River. The Winhall River then runs easterly about 2.5 river miles to the West River. The West River runs to the southeast and flows into the Connecticut River.

The total drainage area at the dam is about 9.98 square miles, of which about 0.32 square miles (204 acres), or about 3%, is actual reservoir surface at the service spillway crest elevation. Being in the southern foothills of the Green Mountains, the topography is characterized by wooded slopes averaging 2% to 20%. The elevation of the drainage area varies from EL 1358 to EL 3260.

5.2 Design Data

Some of the existing records of the hydraulic and hydrologic criteria used in the original design of the dam and reservoir were obtained from the designer of the dam, Haley and Ward Engineers, Inc. (see Appendices B3-1 to B3-7). From this data it appears that the design flood had a peak inflow of 5730 cfs which occurred 6 hours after the start of the event. Other hydraulic design criteria available from the designer were for spillway designs which were not used. This data has not been included with this report. Other engineering data available included design drawings of the dam, contract documents, construction specifications, construction photographs, inspection reports, and data concerning spillway repairs. This data is discussed in Section 2 of this report.

5.3 Experience Data

As noted in Section 2.3 of this report, there are no known records of routine water levels and discharges or of past floods at the dam. Inspection reports between 1972 and 1976, however, indicate the occurrence of storm events which caused erosion damage to the emergency spillway discharge channel. The inspection reports and the erosion damage to the spillway are discussed in Sections 2.2 and 2.3 of this report.

According to NOAA Climatological Data for New England (References 20 and 21), the nearest climatological station is No. 7617, South Londonderry, located at Latitude 43 degrees - 11 minutes

7.2 Recommendations

WITHIN ONE YEAR after their receipt of this Phase I Inspection Report, the Owner should engage a registered engineer qualified in the design of dams to do the following work and provide the consequent recommendations. The Owner should implement those recommendations.

a. Evaluate the design of stone protection on the spillway discharge channel and make the necessary recommendations for repairing the stone protection in the channel.

b. Layout and install piezometers and/or observation wells in the core and downstream shell, and determine whether any downstream drainage provisions should be installed.

c. Install weirs to monitor the seep at the right downstream abutment contact line and to the right of the outlet structure. Monitor quantity and turbidity semi-annually and evaluate the results as they are gathered.

d. Dewater the outlet conduit and the inside of the drop inlet and inspect them.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

WITHIN ONE YEAR after their receipt of this Phase I Inspection Report, the Owner should implement the following operation and maintenance procedures:

1) Cut and remove annually all brush from embankment slopes of the dam and dike and from emergency spillway.

2) Clear, reshape, and provide erosion protection in the zone of natural ground between the downstream toe and the emergency spillway discharge channel.

3) Remove all debris from the emergency spillway annually.

4) Operate the drain port slide gate and determine its status and condition. Also provide for on-site storage of the operating wrench for this gate.

5) Repaint the steel portions of the service bridge to prevent deterioration.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

Gale Meadows Dam is in FAIR condition. Problems include erosion of the riprap in the emergency spillway discharge channel; a seep at the right downstream abutment contact line; a seep at the right downstream side of the outlet conduit; brush on the slope and in the emergency spillway; and erosion in the zone of natural ground between the downstream toe and the emergency spillway discharge channel.

The spillway is ADEQUATE to pass the test flood without overtopping the dam. In accordance with recommended guidelines of the Corps of Engineers, the dam is classified as INTERMEDIATE in size and as having a SIGNIFICANT hazard potential. Accordingly, a TEST FLOOD equal to ONE-HALF PMF (probable maximum flood) was judged as appropriate within the recommended range of one-half PMF to full PMF. The test flood does not overtop the dam, but results in a minimum freeboard of about 0.6 of a foot. Peak inflow for the test flood is 5720 cfs. Peak outflow is reduced by reservoir routing to 4410 cfs. Total project discharge capacity at the top of the dam is due to both the drop inlet service spillway and the emergency overflow spillway (drain port assumed closed) and is equal to 5300 cfs, or 120% of the test flood peak outflow.

b. Adequacy of Information

This Phase I Inspection was based primarily on the visual inspection and the hydraulic and hydrologic computations performed, coupled with sound engineering judgement. Available data consisted of the design/construction drawings, some design calculations, construction specifications, construction photographs, and sewer inspection reports. Such data as the complete design calculations, record drawings, data on the foundation and embankment soils, and operation and performance data were not available. The lack of such in-depth engineering data does not permit a comprehensive review. Therefore, the adequacy of the dam could not be assessed with respect to reviewing design, construction, and operation data.

c. Urgency

WITHIN ONE YEAR after their receipt of this Phase I Inspection Report, the Owner should implement the recommendations given in Section 7.2 and the remedial measures given in Section 7.3.

6.4 Seismic Stability

This dam is in Seismic Zone 2. Therefore, according to recommended guidelines (Reference 1), a seismic stability analysis is not required.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

Based on visual observations the two conditions that could be indicative of future difficulties are the erosion gullies in the emergency spillway discharge channel and the seeps near the downstream toe.

The stone cover on the discharge channel apparently has been eroded due to past flows. Therefore, the sizes of this stone should be checked to determine what remedial measures are needed.

The seeps near the downstream toe of the dam should be monitored, measuring both volume and turbidity, at least two times per year. This data would enable a better evaluation of the seriousness of the seeps during subsequent inspections.

6.2 Design and Construction Data

In the design drawings a central core of clay about 5 feet thick is shown. The shells on each side are compacted fill. The description given in the specifications for these two materials indicate that their permeabilities are nearly the same. The core material may have a higher permeability than the shells, which apparently were specified to be composed of glacial till. For this reason, future evaluations of this dam, and in particular the evaluation of the seeps from the downstream side, should be predicated on the conservative assumption that this dam is homogeneous - not zoned.

Piezometers and/or observation wells should be installed in the core and the downstream shell to determine the water pressure distribution and to judge whether any special drainage provisions should be installed downstream.

6.3 Post-Construction Changes

During an inspection on October 26, 1977 (see Appendix B3-46), it was noted that repairs had been made to the emergency spillway channel by placing quarry-run stone on it. These repairs were carried out because of damage that occurred in and prior to 1976. During the present inspection it was noted that gullies have formed in the quarry-run stone and that the stone seems to have been moved downstream during periods of high flow. Thus, it appears that the quarry-run stone placed in 1977 was not large enough in the zone where the gully formed. This stone should be redesigned so that it will withstand the test flood.

Winhall River has sufficient capacity so as not to be adversely affected by the flow due to a breach of Gale Meadows Dam.

In summary, it appears that increase in flow due to a failure of the dam would result in an increase in damage to a Town highway bridge and the road on either side, damage to a portion of State Route 100, and damage or destruction of one house, a barn, and a house trailer next to State Route 100 due to the large flow of water at about 22 fps going out-of-channel at a stream bend just upstream of the structures. The failure could result in the loss of a few lives. Total economic loss is judged to be appreciable. Therefore, according to recommended guidelines of the Corps of Engineers (Reference 1), the dam is classified as having a significant hazard potential.

and are plotted on Appendix D-1 to define the limit of the hazard area, i.e., the limit of flooding due to the dam failure.

The average velocity of peak flow (flow divided by total flow area) is also listed in Table 5.2 for each downstream station for both flow cases. For the dam breach case, the flow area calculation is shown on each cross section plot starting on Appendix D-19, and consists of storage for the channel reach defined by the cross section divided by reach length. The channel storage was computed by the HEC-1 DB program.

Just prior to the dam breach, outflow from the dam was 5300 cfs, and flow at the first section 1000 feet downstream was about 5.2 feet deep at about 15 fps. After the breach, peak outflow from the dam increases about 2.8 times to 14,700 cfs. This causes flow at Sta 10+00 to increase about 2.8 times to 14,700 cfs, and the water surface to rise from 5.2 to 8.4 feet deep, an increase of 3.2 feet, which floods an area about 170 feet wide. Velocity increases about 1.3 times to 19 fps.

At Sta 10+00, Mill Brook is crossed by a dirt road. The bridge over the brook at this point is a wood-decked structure with concrete abutments (see Photo C-12A). The bridge opening is about 10 feet high by 20 feet wide and can pass about 2300 cfs (modeled as an orifice with 6 feet of head over its centerline due to water level with road). Thus, in both the prior flow and the dam breach condition this bridge cannot pass the flows of 5300 and 14,700 cfs respectively and would probably be damaged or destroyed along with the road approaches.

At Sta 85+00 near 2 houses, a barn, a house trailer, and State Route 100 (formerly State Route 8, see Photos C-12B, C-13A and C-13B) peak flow increases about 2.5 times to 14,400 cfs after the breach. This causes water to rise from 5.0 to 7.8 feet deep, an increase of 2.8 feet. Velocity increases slightly from 19 fps to 22 fps. Ground at the structures is estimated at EL 1140 with the first floors estimated to be slightly higher. While the structures at Sta 85+00 are well above the channel it appears that a large portion of the breach flow would leave the shallow channel on the right side just upstream of Sta 85+00 due to a bend at the top of the rock channel visible in Photo C-12B. Upon leaving the channel this flow would flood one of the houses, the barn, and the house trailer (see Photos C-13A and C-13B). Due to the amount and velocity of this out-of-channel flow these structures would be damaged or destroyed and the loss of a few lives could occur. This flow would also probably damage a portion of State Route 100 just downstream of the house trailer (see Photo C-13B) and then would return to the stream channel below this road.

The routing was not carried out any further downstream because there are no structures near Mill Brook from Sta 85+00 down to where it joins the Winhall River. It appears that the

TABLE 5.2

GALE MEADOWS DAM

DAM FAILURE ANALYSIS

CONDITIONS — Top of Dam EL 1365
Service Spillway Crest EL 1358
Total Project Discharge Capacity at Top of Dam = 5300 cfs ± due to service and emergency spillways.
Drain port closed.

	Approx. Peak Flow (cfs)	Time to Peak Flow (hours)	Approx. Max. Water Surface			
			Elev. (feet)	Depth (feet)	Top Width (feet)	Avg. Vel. (fps)
PRIOR FLOW AT TOP OF DAM						
Inflow = Outflow = Total Project Discharge Capacity at Top of Dam Start Routing at Top of Dam						
Dam	5300	--	1365.0	27.0	---	--
Sta 10+00 Bridge	5300	--	1325.2	5.2	---	15
Sta 45+00	5300	--	1245.8	5.8	---	16
Sta 85+00 Houses	5300	--	1125.0	5.0	---	19
BREACH AT TOP OF DAM						
Inflow = zero Start Routing at Top of Dam Start Breach W.S. at Top of Dam Time of Failure = 0.00 hour Breach Time = 1.85 hour Breach Width = 40 feet Breach Depth = 27 feet Trapezoid, 0.5H:1V side slopes						
Dam	14,700	1.87	1365.0	27.0	---	--
Sta 10+00 Bridge	14,700	1.87	1328.4	8.4	170	19
Sta 45+00	14,500	1.90	1248.7	8.7	190	18
Sta 85+00 Houses	14,400	1.93	1127.8	7.8	160	22

The inputted cross sections defining the downstream channel reaches were developed from and are located on the USGS map included as Appendix D-1. Hand plottings of the cross sections start on Appendix D-19. Normal depth channel routing was performed by the HEC-1 DB program using the Manning's n values for left overbank, channel, and right overbank as listed on each cross section plot. The overbank points and the actual channel section in between are only an approximation of the true natural channel. This is because of the constraints of the small scale USGS map that the cross sections were developed from and of the limited 8-point cross section accepted by the program. The third and sixth point on each cross section are defined as the overbank points. Therefore, distinguishing between in-channel and overbank flow cannot be done reliably by simple comparison of computed water surface depth with the defined overbank points. It must be done by judging the calculated quantity, depth, width, and velocity of flow against the real channel cross section and configuration as it exists.

b. Results of Analysis

The results of the dam failure analysis using the HEC-1 DB program are summarized in Table 5.2. PRIOR FLOW AT TOP OF DAM establishes initial conditions downstream due to steady state total project dicharge capacity at the top of dam with no dam breach. The computer input and selected pages of the computer output start on Appendix D-21.

BREACH AT TOP OF DAM is a major sudden failure of the dam under the conditions previously discussed in Section 5.5.a. Results are summarized in Table 5.2 for all stations, with the computer input and selected pages of the computer output starting on Appendix D-25.

From the statement on Appendix D-26, note that the time interval for breach development and for downstream routing are the same (i.e., 2 minutes = 0.033 hours). This permits the interpolated breach hydrograph at the standard time interval to match the computed breach hydrograph. Only the interpolated breach hydrograph is routed downstream.

Appendix D-27 is a computer plot of the complete outflow hydrograph during and after the breach.

c. Hazard Evaluation

For a sudden major dam failure, BREACH AT TOP OF DAM, the computed maximum water surface elevation for each downstream station is tabulated in Table 5.2 and is plotted on each cross-section beginning on Appendix D-19. The top widths of flow determined from each cross section are tabulated in Table 5.2

about 0.6 of a foot. Peak inflow for the test flood is 5720 cfs, or 573 csm (cfs per square mile). Peak outflow is reduced by reservoir routing to 4410 cfs, or 442 csm, and occurs about 22 hours after the start of the storm. The peak portion of the inflow and outflow hydrograph for the test flood of one-half PMF is shown by the computer plot on Appendix D-16. Total project discharge capacity at the top of the dam is due to both the drop inlet service spillway and the emergency overflow spillway (drain port assumed closed) and is equal to 5300 cfs, or 120% of the test flood peak outflow.

5.5 Dam Failure Analysis

a. Failure Conditions

In order to evaluate the downstream hazard, the flood flow just prior to and then due to an assumed major failure or breach of the dam was routed downstream using the HEC-1 DB program. Stream conditions just prior to and after the assumed failure were compared. Corps of Engineers' criteria call for breaching the dam with no inflow flood and with the water surface static at the top of the dam, or static at the test flood pool if a test flood of full PMF does not overtop the dam. Since the overtopping analysis shows that the test flood of one-half PMF does not overtop the dam, the dam breach was begun at time zero with the water surface at the top of the dam. The contents of the reservoir were routed through the breach as the breach progressed.

1376 To model a sudden major dam breach, maximum breach geometry was selected as follows: constant trapezoidal shape with 0.5H:1V side slopes, breach width across the bottom of the trapezoid equal to the bottom width of the original valley (approximately 40 feet), and a breach depth below the top of the dam equal to 27 feet (down to EL 1338), which approximates a full depth failure that would completely drain the reservoir. Breach geometry is illustrated on Appendix D-24.

Breach time, or time for the breach width to progress from the top to the bottom of the dam, was selected so that the peak outflow using the HEC-1 DB program would approximate that computed by the Corps of Engineers' "Rule of Thumb" method using the same breach width and depth, plus additional flow equal to total spillway capacity at top of dam, since the breach could be located separate from the spillway (both service and emergency). The selection of breach time is shown on Appendix D-24. Rule of Thumb peak breach outflow is about 9400 cfs. Additional flow due to spillway capacity is about 5300 cfs. Therefore, total peak outflow from the dam is about 14,700 cfs. A breach time of 1.85 hours, or 111 minutes, was selected for the HEC-1 DB program, which results in a peak outflow of about 14,700 cfs.

TABLE 5.1

GALE MEADOWS DAM

OVERTOPPING ANALYSIS

CONDITIONS — Total Drainage Area = 9.98 square miles
Start Routing at Service Spillway Crest EL 1358
Top of Dam EL 1365
Total Project Discharge Capacity at Top of Dam = 5300 cfs ± due to service and emergency spillways.
Drain port closed.
Some values rounded from computed results.

	TEST FLOOD ONE-HALF PMF (a)
INFLOW	
24-hour Rainfall (inches)	11.4 (b)
24-hour Rainfall Excess (inches) (c)	8.7 (d)
Peak Inflow (cfs)	5720
Peak Inflow (csm)	573
OUTFLOW	
Peak Outflow (cfs)	4410
Peak Outflow (csm)	442
Time to Peak Outflow (hours)	21.9
Maximum Storage (acre-feet)	2786
Max. W.S. Elevation (feet-NGVD)	1364.4
Minimum Freeboard (feet)	0.6
Maximum Depth over Dam (feet)	not overtopped
Duration of Overtopping (hours)	n/a

(a) One-half of full PMF total runoff, including base flow. For one-half PMF base flow = 2 cfs per square mile = 20 cfs ±

(b) Approximation assuming total losses are the same as for the full PMF. Full PMF 24-hour rainfall equals 20.1 inches.

(c) Rainfall Excess = Rainfall for the Reservoir Surface. For the rest of the drainage area, losses are assumed to be 1.0 inch initially and 0.1 inch per hour thereafter.

(d) Equal to one-half of full PMF value. Full PMF 24-hour rainfall excess for the land surface equals 17.4 inches.

square miles or less) were input to the program as percentages of the index PMP in accordance with HMR 33. A storm reduction coefficient was then applied internally by the program in order to transpose or center the storm over the actual total drainage area. Thus, the corrected 24-hour PMP for the actual total drainage area became 20.1 inches.

In accordance with accepted practice, floods as ratios of the PMF (e.g., one-half PMF) were taken as ratios of runoff, not of precipitation. The HEC-1 DB program applies the ratio to total runoff, including base flow. This method of applying the ratio introduces an increasing error in base flow as the ratio of the PMF gets smaller. However, this error was eliminated by inputting twice the desired base flow to the full PMF so that one-half PMF, the test flood, would have the correct base flow.

All precipitation was distributed by the program using the built-in Standard Project Storm arrangement of EM 1110-2-1411 (Reference 13), including the percentage distribution for the maximum 6-hour precipitation, and by both the built-in arrangement and percentage distribution from HYDRO-35 (Reference 6) for the maximum 1-hour precipitation.

Appendix D-11 summarizes the subarea, loss rate, and unit hydrograph data input to the program. Only two subareas were used. Subarea 1 consists of all the drainage area around the reservoir, and Subarea 2 consists of just the reservoir surface. For the land in Subarea 1, loss rates were assumed to be 1.0 inch initially and a constant 0.1 inch per hour thereafter. Snyder unit hydrograph coefficients were assumed for average conditions and used to compute a conservative standard lag time. The program uses the inputted Snyder peaking coefficient and lag time to solve by iteration for approximate Clark coefficients, which are then used to calculate the runoff hydrograph.

3684 For the reservoir surface making up Subarea 2, loss rates were set to zero so that rainfall would equal rainfall excess, or runoff. Assuming no delay in the rainfall/runoff response, a constant unit hydrograph for a rainfall duration equal to the HEC-1 DB calculation interval was developed per Appendix D-11 and input to the program.

f. Overtopping Potential

The results of the overtopping analysis using the HEC-1 DB program are summarized in Table 5.1. The overtopping analysis computer input and output for the test flood of one-half PMF are included starting on Appendix D-12.

As noted from Table 5.1, the test flood of one-half PMF does not overtop the dam, but results in a minimum freeboard of

spillways was input directly to the HEC-1 DB program. Flow over the dam was computed by the HEC-1 DB program assuming critical flow over a rectangular broad-crested weir with a level crest length equal to the total length of just the dam without the emergency spillway. The top of dam elevation, length, appropriate discharge coefficient, and exponent of head were input into the program. The formula used for the computation, as well as the results of hand computation at selected points, are shown on Appendix D-9.

With the reservoir at the top of dam, EL 1365, the total discharge from the dam is about 540 + 4760 = 5300 cfs. This is due to both the service and emergency spillways. Also, with an average discharge from both spillways of about 2650 cfs over the 7-foot depth from the top of the dam down to the service spillway crest, it would take about 7.3 hours for the spillways to drain the 1604 acre-feet of storage between the top of the dam and the service spillway crest, or about 1 hour per foot, all assuming no inflow.

d. Selection of Test flood

Based on the dam failure analysis presented later in Section 5.5, Gale Meadows Dam is classified as having a significant hazard potential. The increase in flow due to a failure of the dam would result in appreciable economic loss and possible loss of a few lives caused by an increase in damage to a Town highway bridge and the road on either side, damage to a portion of State Route 100, and damage or destruction of one house, a barn, and a house trailer next to State Route 100 due to the large flow of water at about 22 fps going out-of-channel at a stream bend just upstream of the structures. Since the dam is also classified as intermediate in size (see Section 1.2.c), recommended guidelines of the Corps of Engineers (Reference 1) indicate a test flood in the range of one-half PMF (probable maximum flood) to full PMF. Since the dam is near the lower end of its intermediate size range with regard to storage (2942 acre feet within the 1000 to 50,000 acre-foot range), and since there is limited potential for future development in the hazard area, the test flood selected for this evaluation was one-half PMF (per Table 5.1, peak inflow = 5720 cfs, peak outflow = 4410 cfs).

The PMF event is that hypothetical flood flow produced by the most critical combination of precipitation, minimum infiltration loss, and concentration of runoff that is considered reasonably possible for a particular drainage area.

e. Development of Test Flood

The index PMP (probable maximum precipitation) input to the computer program was 19.0 inches for a 24-hour duration all-season storm over a 200-square mile basin, according to HMR 33 (Reference 4). Maximum 6-hour, 12-hour, and 24-hour precipitation for the actual size of the drainage area (same for 10

1375

c. Discharge Capacity

The dam has a drop inlet service spillway and an emergency free overflow spillway. Referring to the design/construction plans in Appendix B2, the service spillway consists of a straight weir crest on four sides of a rectangular concrete outlet structure (27 feet total effective crest length with stop planks in place), a vertical concrete transition 20 feet deep, and a closed concrete spillway outlet conduit 5 feet in diameter, about 180 feet long, with a slope of 1.7%.

The discharge capacity of each of the four service spillway weirs was conservatively computed assuming that the drop inlet entrance acted as a rectangular sharp-crested weir with end contractions up to a flow over the weir of about 3 feet. For water depths greater than 3 feet the service spillway capacity is controlled by the capacity of the spillway outlet conduit. The outlet conduit capacity was computed by applying Bernoulli's Equation, with Manning's Equation used for friction losses together with an appropriate entrance loss. The computations are presented on Appendices D-5 and D-6. With water 7 feet over the service spillway crest, (i.e., water 5 feet over the emergency spillway crest and level at the top of dam), the service spillway discharges a total of about 540 cfs.

Referring to the engineering data in Appendix B and various photos in Appendix C, the emergency free overflow spillway consists of an approach section, a concrete overflow weir control section about 5 feet below the top of the dam, and a discharge channel about 250 feet long excavated into earth along the left abutment. The effective crest length of the weir control section is 120 feet with additional sloped sections on each side.

The discharge capacity of the emergency spillway was computed assuming critical flow through a trapezoidal spillway opening. The computations are presented on Appendices D-6, D-7, and D-8. With water 5 feet over the emergency spillway crest (i.e., water level at the top of dam), the emergency spillway discharges about 4760 cfs.

Taking the service spillway crest at EL 1358, the emergency spillway crest at EL 1360, and the top of dam at EL 1365, the total discharge computations are summarized on Appendix D-9 and graphed on Appendix D-10. Total discharge from the dam is the sum of the discharges from the service and emergency spillways, plus flow over the dam for the overtopping condition. As
1368 discussed previously in Section 5.4.a, the drain port was assumed closed and not contributing to the total discharge capacity. The sum of the hand-computed discharges for the service and emergency

North, Longitude 72 degrees - 49 minutes West. The station is recording, and precipitation and temperature observations are made. Years of record start in 1939. The station is identified on the Vicinity Map at the beginning of this report and is located about 3 miles northeast of Gale Meadows Dam.

5.4 Test Flood Analysis

a. Initial Conditions

The U.S. Army Corps of Engineers Hydrologic Engineering Center's Program HEC-1 DB (Reference 3) was used to develop the test flood hydrology and perform the reservoir routing.

The purpose of this analysis was to evaluate the dam and its spillways with respect to the adequacy of their surcharge storage and discharge capacity. Accordingly, it was assumed that the water surface was at the service spillway crest at the start of the flood routing. For all conditions, the stop planks of the service spillway were assumed to be in place and the drain port was assumed to be closed, both of which represent normal conditions.

A constant base flow of 2 cfs per square mile was chosen to represent average conditions in the drainage area and was input into the computer program for all subareas.

b. Storage Capacity

Using a bathymetric map of the pond prepared by the Vermont Fish and Game Department (see Appendix B3-31), supplemented by other plans of the pond (Appendices B2-1 and B2-6), and by USGS contour mapping (Appendix D-1) above the top of dam, areas inside contour elevations were measured and the capacity of the reservoir was computed using the method of conic sections. The computations were done by the HEC-1 DB computer program with the results on Appendices D-15 and D-18. A hand tabulation of the input and the computed results is on Appendix D-2.

Measured area at the service spillway crest (EL 1358) is about 3% less than the value reported on a survey drawing (204 acres measures vs. 210 acres of flowage reported on Appendix B2-6).

Using the measured and computed values, stage-area and stage-storage curves are presented on Appendices D-3 and D-4 respectively. At the drop inlet service spillway crest, EL 1358, the reservoir has a surface area of 204 acres and a total capacity of 1338 acre-feet. At the top of dam, EL 1365, the surface increases to 261 acres and the capacity to 2942 acre-feet, or about 959 million gallons. Surcharge storage between the service spillway crest and the top of dam amounts to 1604 acre-feet, or about 3.0 inches of runoff from the 9.98 square-mile drainage area. Therefore, the pond has some capacity to attenuate peak inflow.

6) Develop and implement effective routine operation and maintenance procedures for the dam and its appurtenances.

7) Develop an "Emergency Action Plan" that will include an effective downstream warning system; locations of emergency equipment, materials, and manpower; authorities to contact; and potential areas that require evacuation.

8) Institute a program of annual periodic technical inspection of the dam and dike. During the inspection check the six vertical cracks in the concrete weir of the emergency spillway for possible worsening condition.

7.4 Alternatives

No practical alternatives exist to the recommendations and remedial measures contained in this report.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
DAM INSPECTION

DAM GALE MEADOWS DAM — DATE November 19, 1979

ID NO. VT 00115 — TIME 0900 - 1230

TOWN Londonderry — WEATHER Mostly sunny 45° - 68° F.

COUNTY Windham — W.S. ELEV. 1358.2+ UPSTREAM

STATE Vermont — 1335 + DOWNSTREAM

INSPECTION PARTY	RECORDER (X)
1. Thomas Bennedum, Gordon E. Ainsworth & Associates, Inc.	X
2. Edwin Vopelak, Jr., Gordon E. Ainsworth & Assoc., Inc.	
3. John Kenworthy, Gordon E. Ainsworth & Assoc., Inc.	
4. Steve J. Poulos, Geotechnical Engineers, Inc.	X
5. Peter Barranco, Jr., Vermont Dept. of Water Resources	
6. John Guilmette, Facilities Engineer, Vermont Fish and Game Dept.	
7.	
8.	
9.	
10.	

PROJECT FEATURE/DISCIPLINE	INSPECTOR	REMARKS
1. H & H	T. Bennedum	-
2. Geotechnical	S. Poulos	-
3. Structural	T. Bennedum	-
4. Mechanical	T. Bennedum	-
5. Electrical	None	N/A
6.		

VISUAL INSPECTION CHECKLIST

PROJECT GALE MEADOWS DAM DATE Nov. 19, 1979

PROJECT FEATURE - - - - NAME - - - -

DISCIPLINE Geotechnical NAME S. J. Poulos

	AREA EVALUATED	CONDITION
	DAM EMBANKMENT	
	1 Crest Elevation	EL 1365
	2 Current Pool Elevation	EL 1358.2
	3 Maximum Impoundment to Date	Unknown.
GEI	4 Surface Cracks	None observed.
GEI	5 Pavement Condition	None.
GEI	6 Movement or Settlement of Crest	Slight dip parallel to and 8' upstream from downstream crestline. Crest is dirt.
GEI	7 Lateral Movement	None observed.
GEI	8 Vertical Alignment	OK.
GEI	9 Horizontal Alignment	OK.
GEI	10 Condition at Abutment and at Concrete Structures	Seep approx. 10 gpm to rt of outlet structure. Iron staining at 3-4 ft above toeline. Top of seep is at that level. Rt. abut.: seep 3-5 gpm with iron staining below. Seems to emanate at 5' (elev.) above toeline just a foot above the one at outlet structure.
GEI	Indications of Movement of Structural Items on Slopes	None observed.
GEI	Trespassing on Slopes	Free access for fishing.
GEI	Sloughing or Erosion of Slopes or Abutments	One worn path down center of downstream slope to outlet structure. One path 1½' above riprap on upstream face.
GEI	Rock Slope Protection-Riprap Failures	Riprap wave cut at shoreline, but looks okay.
GEI	Unusual Movement or Cracking at or Near Toe	None observed.
GEI	Unusual Embankment or Downstream Seepage	See Item 10.
GEI	Piping or Boils	None observed.
GEI	Foundation Drainage Features	None.
GEI	Toe Drains	None.
GEI	Instrumentation System	None.
GEI	Vegetation	Waist-high grass. Trees to 3-in.-dia. formerly - stumps remain.

VISUAL INSPECTION CHECKLIST

PROJECT GALE MEADOWS DAM DATE Nov. 19, 1979

PROJECT FEATURE - - - - NAME - - - -

DISCIPLINE Geotechnical NAME S. J. Poulos

	AREA EVALUATED	CONDITION
	DIKE EMBANKMENT	
	Crest Elevation	Crest width 9 ft, elev. 6.1 above water.
	Current Pool Elevation	EL 1364.3 ± Design EL 1365
	Maximum Impoundment to Date	EL 1358.2
GEI	Surface Cracks	Unknown. Not observable.
GEI	Pavement Condition	None.
EI	Movement or Settlement of Crest	Generally irregular with approx. 6" hump in the middle.
GEI	Lateral Movement	Not observable.
GEI	Vertical Alignment	Not observable.
EI	Horizontal Alignment	Not observable.
GEI	Condition at Abutment and at Concrete Structures	OK.
GEI	Indications of Movement of Structural Items on Slopes	None.
GEI	Trespassing on Slopes	Free access.
EI	Sloughing or Erosion of Slopes or Abutments	DS: One hole on face 20' rt from left abutment about midslope. US: Irregular surface. Perhaps minor sloughing.
EI	Rock Slope Protection - Riprap Failures	None.
GEI	Unusual Movement or Cracking at or Near Toes	None.
GEI	Unusual Embankment or Downstream Seepage	None. Water collected downstream in a low spot that appears to be natural swamp.
GEI	Piping or Boils	None.
EI	Foundation Drainage Features	None.
GEI	Toe Drains	None.
EI	Instrumentation System	None.
GEI	Vegetation	DS: Brush to 3' high. US: Alder to 15' high about 3' above water. Roots are concentrated in groups.

VISUAL INSPECTION CHECKLIST

DAM GALE MEADOWS DAM DATE Nov. 19, 1979

DISCIPLINE Structural/H & H INSPECTOR T. Bennedum

DISCIPLINE Geotechnical INSPECTOR S. J. Poulos

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Drop inlet service spillway
a. Approach Channel	N/A - Lake surrounds structure.
Slope Conditions	Grass and brush to 10 ft. from shoreline, then wooded.
Bottom Conditions	Bottom of pond.
Rock Slides or Falls	None
Log Boom	None
Debris	Some small sticks against rack.
Condition of Concrete Lining	N/A
Drains or Weep Holes	N/A
b. Intake Structure	
Condition of Concrete	Good. Some erosion at sides of weir and on inside walls. No cracks observed.
Stop Logs and Slots	Good. Some rust on metal in slot supports.

VISUAL INSPECTION CHECKLIST

DAM GALE MEADOWS DAM DATE November 19, 1979

5

DISCIPLINE Structural/Mechanical INSPECTOR T. Bennedum

DISCIPLINE No Geotechnical Features INSPECTOR - - - -

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Slide Gate and Operating Nut.
a. Concrete and Structural	Same as intake structure.
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	Top of structure open.
Float Wells	None.
Crane Hoist	None.
Elevator	None.
Hydraulic System	None.
Service Gates	None.
Emergency Gates	Not Observable. Need 2" valve wrench to operate. None available. Appears good.
Lightning Protection System	None.
Emergency Power System	None.
Wiring and Lighting System	None.

VISUAL INSPECTION CHECKLIST

DAM GALE MEADOWS DAM DATE Nov. 19, 1979

6

DISCIPLINE Structural/H & H INSPECTOR T. Bennedum

DISCIPLINE No Geotechnical Features INSPECTOR - - -

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not observable due to poor access and amount of flow. Consists of a 20' deep rectangular vertical concrete section from the drop inlet weir crest with a 5-foot diameter concrete outlet conduit at the bottom about 180 feet long through the dam which discharges into Mill Brook.
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

VISUAL INSPECTION CHECKLIST

DAM GALE MEADOWS DAM DATE Nov. 19, 1979

DISCIPLINE Structural/H & H INSPECTOR T. Bennedum

DISCIPLINE Geotechnical INSPECTOR S. J. Poulos

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AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Outlet consists of 5-foot diameter concrete pipe and headwall with wingwalls.
General Condition of Concrete	Good to excellent.
Rust or Staining	None observed.
Spalling	None observed.
Erosion or Cavitation	None observed.
Visible Reinforcing	None observed.
Any Seepage or Efflorescence	None observed.
Condition at Joints	N/A
EI Drain holes	None.
GEI Channel	
EI Loose Rock or Trees Overhanging Channel	Many trees overhanging channel. Loose rock also but not significant.
EI Condition of Discharge Channel	Fair due to trees.
Other	Canvas flap over outlet pipe removed.

VISUAL INSPECTION CHECKLIST

DAM GALE MEADOWS DAM DATE Nov. 19, 1979

DISCIPLINE Structural H/H INSPECTOR T. Bennedum

DISCIPLINE Geotechnical INSPECTOR S. J. Poulos

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AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Emergency Overflow Spillway
a. Approach Channel	Reservoir bottom.
General Condition	Good.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None. Wooded shoreline. Some trees could fall in.
Floor of Approach Channel	Not visible.
b. Weir and Training Walls	8" wide weir crest.
General Condition of Concrete	Good to excellent. Appears to be slight downstream bow of weir at centerline near construction joint.
Rust or Staining	None observed.
Spalling	None observed.
Any Visible Reinforcing	None observed.
Any Seepage or Efflorescence	Very minor at one crack. Six cracks through section at various places. Worst crack is 15 feet from right at junction of level weir crest and sloped section.
Drain Holes	N/A
c. Discharge Channel	Fair.
General Condition	None.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Brush to 10' high. Logs on spillway. Generally needs cleanup. Some erosion of sides of spillway. Spillway eroded on side where cover is absent. Some of the stone is eroded away. Locally stone was not large enough.
Floor of Channel	None.
Other Obstructions	

VISUAL INSPECTION CHECKLIST

DAM GALE MEADOWS DAM DATE Nov. 19, 1979

DISCIPLINE Structural INSPECTOR T. Bennedum

DISCIPLINE No Geotechnical Feature INSPECTOR - -

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	
Bearings	Good.
Anchor Bolts	N/A.
Bridge Seat	Good.
Longitudinal Members	Rusty. Needs painting.
Underside of Deck	Fair. Wood untreated.
Secondary Bracing	Fair. Wood untreated.
Deck	Fair. Wood untreated.
Drainage system	N/A
Railings	Good. Need painting from dam to gate.
Expansion Joints	Good.
Paint	Needs painting.
b. Abutment & Piers	
General Condition of Concrete	Good to excellent.
Alignment of Abutment	Good.
Approach to Bridge	O.K. Stone steps.
Condition of Seat & Backwall	Good but rusty. Needs painting.

APPENDIX B

ENGINEERING DATA

Section	Description
B1	Listing of Locations for Available Records and Data
B2	Drawings
B3	Copies of Past Inspection Reports and Data

APPENDIX B

SECTION 1

LISTING OF LOCATIONS FOR AVAILABLE RECORDS AND DATA

a. Owner: Vermont Fish and Game Department
Agency of Environmental Conservation
79 River Street - State Office Building
Montpelier, Vermont 05602
Attention: Edward F. Kehoe, Commissioner
(802) 828-3371

1) Plans, sections, and details
2) Correspondence
3) Inspection reports

b. Designer: Haley and Ward Engineers, Inc.
25 Fox Road
Waltham, Massachusetts 02154
Attention: Mr. Charles Miller
(617) 890-3980

1) Design calculations
2) Plans, sections, and details
3) Construction photographs

c. Construction Contractor: Unknown.

d. Agency of Environmental Conservation
Department of Water Resources
Water Quality Division
Montpelier, Vermont 05602
Attention: A. Peter Barranco, Jr., P.E.,
Dam Safety Engineer
(802) 828-2761

1) Contract and specifications
2) Drawings and plans
3) Correspondence
4) Inspection reports

APPENDIX B

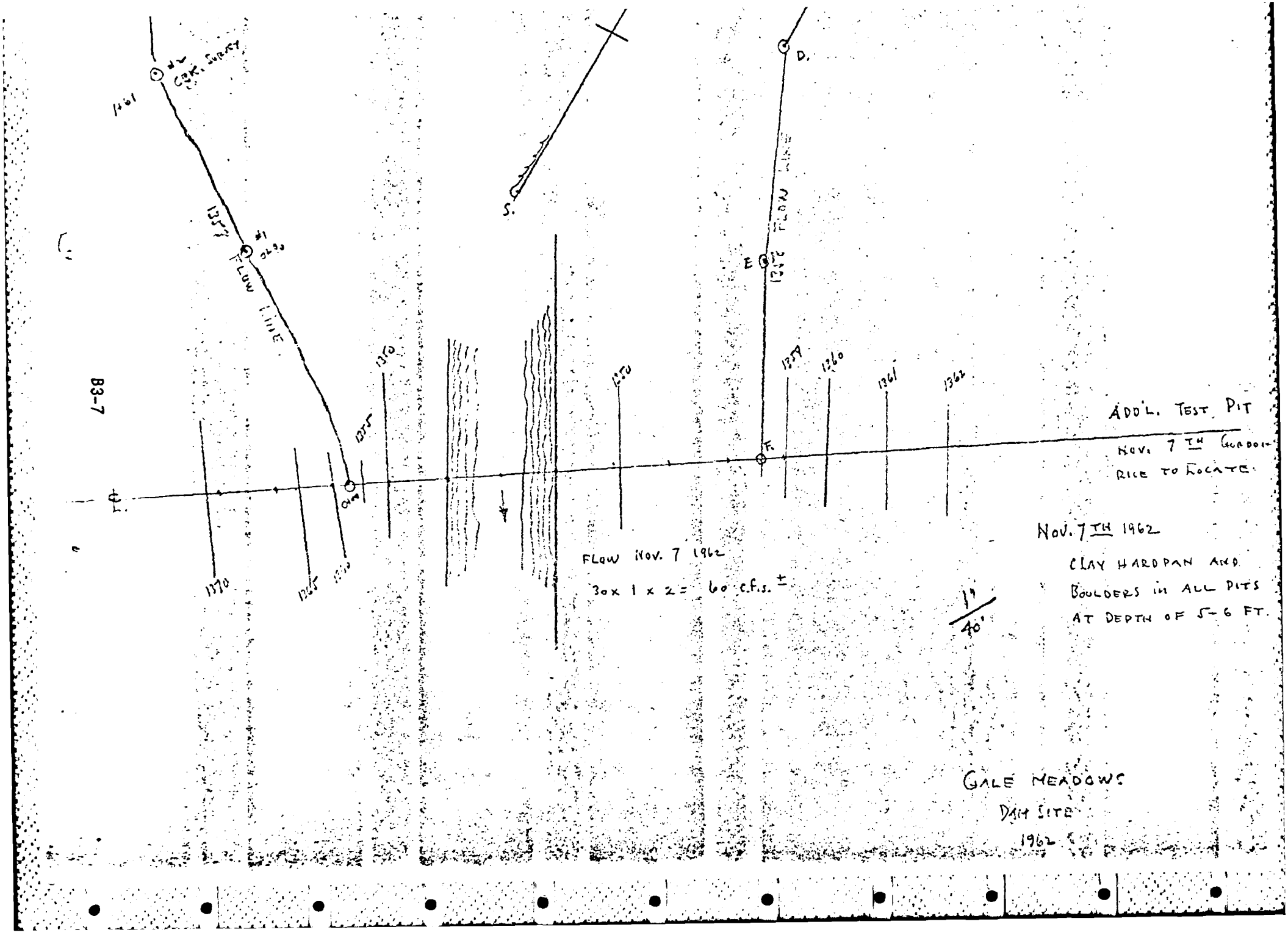
SECTION B2

DRAWINGS

TABLE OF CONTENTS

	Page
DESIGN/CONSTRUCTION DRAWINGS[1] - December 1964	
General Location Plan and Dam Site - Sheet 1 of 10	B2-1
Finished Work Plan and Dam Section - Sheet 7 of 10	B2-2
Sections of Dam and Plan of Dike - Sheet 8 of 10	B2-3
Structural Details - Sheet 9 of 10	B2-4
Steel Reinforcement - Sheet 10 of 10	B2-5
BOUNDARY SURVEY OF IMPOUNDMENT - May 1965	B2-6

(1) Original set consists of 10 drawings covering the entire dam site, pond site, and access roads. Only those drawings pertinent to the dam are included herein.


B3-7
#1 CSK. SURVEY
#1
FLOW LINE
S.
D.
E
F.
1361
1355
1350
1345
1340
1359
1360
1361
1362
1370
1365
1360
ADD'L. TEST PIT
NOV. 7TH GUARDS RICE TO LOCATE
NOV. 7TH 1962
CLAY HARDPAN AND BOULDERS IN ALL PITS AT DEPTH OF 5-6 FT.
FLOW NOV. 7 1962
30 x 1 x 2 = 60 c.f.s. ±
1" = 10'
GALE MEADOWS
DAM SITE
1962

Gale Meadows
Oct. 30, 1962

Routing Curve Calculations.

area

Storm similar to Oct. 5-6-7 around Boston metropolitan area. 9" to 10" in 60 hours

For this calculation assume 12" continuous rain for 72 hours.

RESOURCES OCT. REPORT
Oct 5-6-7
Boston 7.01"
3rd greatest 9 days
Except Aug 1955
Sept 1938
At Reading 12.01"
Ipswich at S. Middleton
43.4 □ mi. MAX 1857 c.f.s.
This Oct 1911 c.f.s.
1938-1962 24 yrs. record

Drainage area = 6784 acres / 10.6 □ miles
6784 acres for actual boundaries

Water surface at Elev. 1358 = 210 acres.

Valley slope 25 ft. per thousand
" length 40 000'

Time of concentration $\frac{40\,000}{1.75 \text{ F.p.s.}}$ = 23000 sec ÷ 60 = 384 min ÷ 60 = 6.4 hours

For approximation B/2 formula

c.f.s./A = (C=.1) × c.f.s./A $\left(\frac{12"}{72}\right)$ × $\sqrt[4]{\frac{25.00}{5730}}$ 6784

= .10 × .1675 × $\sqrt[4]{.00435}$ = $\sqrt{.066}$ = .257 .257 = .0043 × 5730 =
= .3 × 2"/hr. max. intensity. .15 × 5730 = 859 c.f.s.
6784 = 1000 c.f.s. ±

Water Resources Board Specify $\frac{6600 \text{ c.f.s.}}{12.2 \text{ □ mi.}}$ = 540/□' × 10.6 5730 c.f.s.

For 2" max. intensity during storm Runoff = 1000 c.f.s. ±
For 5730 c.f.s. (State) × 60% = Storage Capacity 3430 c.f.s.
State figure $\frac{3430}{1000}$ × 2" = 6.8"/hour max. intensity using B/2 formula.

Use background for spillway capacity, either overflow type or emergency — Future routing curve for drainage area with pond surface of 210 A. at elevation 1358.

$$V = h\left(\frac{q_0 + q_1}{2} + \frac{q_1 + q_2}{2}\right.$$

q_0 = 210A				
q_1 = 211.71	210.87	× 1	= Acre-ft.	210.87
q_1 = 211.71				
q_2 = 214.71	213.21			424.62
q_2 214.71				
q_3 218.50	216.61			640.67
q_3 218.5				
q_4 223.0	220.75			861.42
q_4 223.0				
q_5 228.0	225.50			1086.92
q_5 228.0				
q_6 233.75	230.9			1317.82
q_6 237.71				
q_7 240.00	237.			1554.82

Area of Reservoir 210 Acres.

" " Watershed 10 Sq. Mi.

one inch in 24 hr 270 c.f.s

one inch in depth 23 232000 cu ft.

Length of shoreline $10\sqrt{210}$ 4.6 Miles.

Using Reservoir Max of 5730 c.f.s.

for 6784 A = .845"/per hour

for Vermont this intensity would have a duration of an hour once in 2 years.

.845"/hr = .845 c.f.s./A.

5730 c.f.s. = 955 c.f.s./hr.

Also equals 955 × 3600.00 = 344 000 Acre-ft./hour

344000 x 6 hr = 2,064,000 } acre-ft.

5730 c.f.s x 60 x 60 = 2,062,800 }

RUN OFF RATE C.F.S.

HR	CFS.	ACRES
1hr =	955	1630
2hr =	1910	2260
3hr =	2860	3390
4 hr.	3820	4520
5 hr	4775	5650
6 hr.	5730	MAX. 6784
7	5400	6550
8	5150	6575
9	5000	5900
10	4850	5700
11	4700	
12	4600	
13	4500	
14	4350	
15	4250	
16	4125	
17	4075	
18	4000	
19	3900	
20	3800	
21	3750	
22	3650	
23	3560	
24	3475	
25	3400	

Reservoir Outflows

TIME INT. HR — (1.)	INFLOW I cfs. (2.)	AV. INFLOW (3.)	$\frac{S}{\Delta t} - \frac{Q}{2}$ AT START (4.)	$\frac{S}{\Delta t} + \frac{Q}{2}$ AT END (5.)	HEAD ON SPILLWAY ft. (6.)	OUTFLOW Q cfs. (7.)
0.	175.	0	0			
1.	200.	187	195	422		
2.	600.	400	330	730		
3.	1250.	925	378	1278		
4.	2200.	1725	[illegible]	1999		
5.	3300.	2750	638	[illegible]		
6. MAX.	5200.	4250.	455	5015		
7.	5200.	5200				
8.	4000	4600				
9.	3000	3500				
10.	2200.	2600				
11.	1400	1800				
12.	900	1150				
13.	500.	700.				

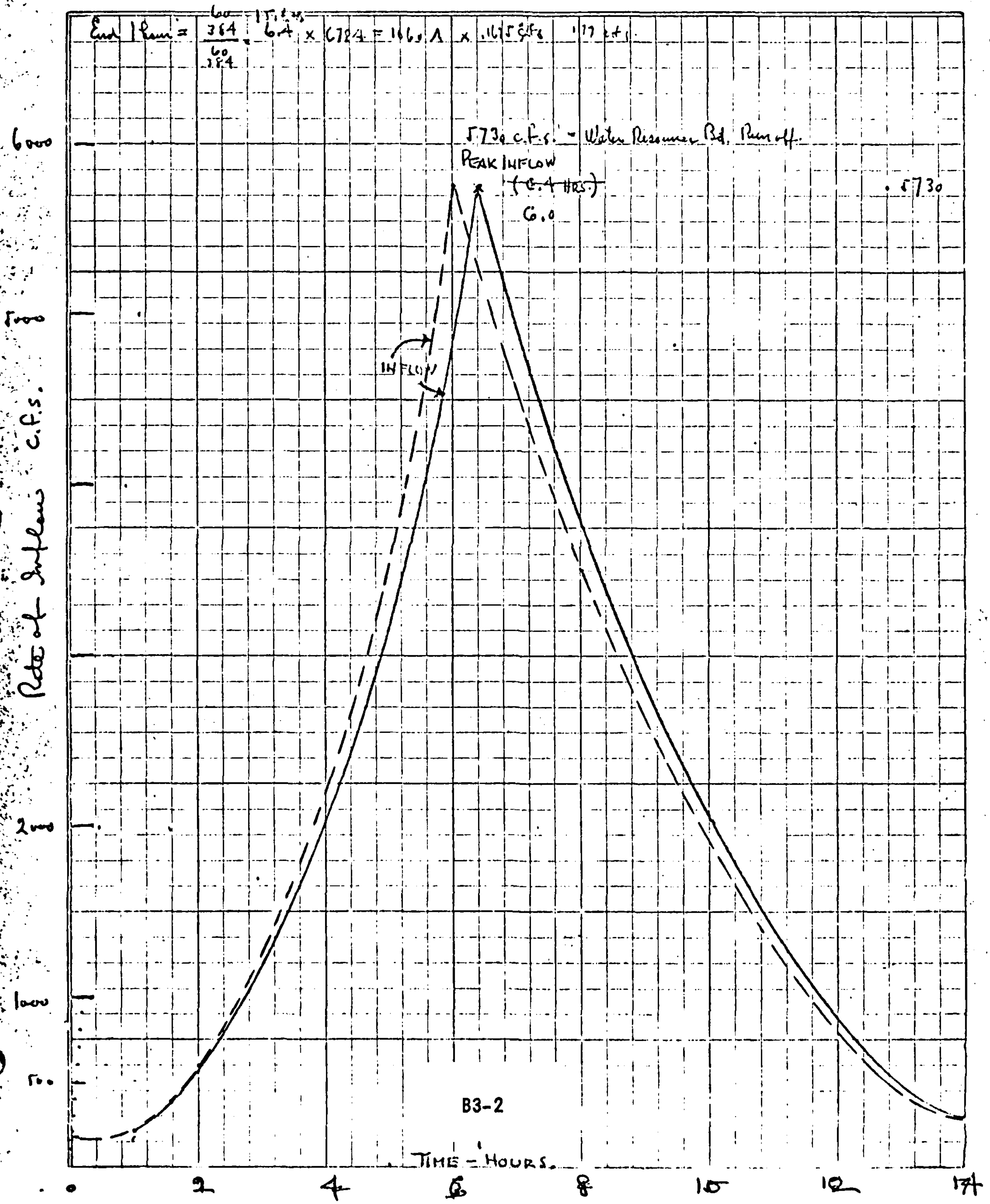
Time Interval 1 hr = 60 min. = 3600 sec.

Haley and Ward
ENGINEERS
Boston

SUBJECT Gole Meadows

Rate of Inflow.

SHEET ____ OF ____
COMPUTER ________
CHECKED BY ________
DATE ________



BURKLI - ZIEGLER

(1 inches / hour = c.f.s. / acre)

c.f.s. = Area in Acres x Cur. Rate of Rainfall during max. inch/hr

$$\overset{(C)}{.25} \times \sqrt[4]{\frac{\text{Slope in feet / thousand}}{\text{Drainage Area in acres.}}}$$

Yale Meadows.

6784 Acres

25' / Thousand

For a rainfall intensity of 4"/hr = 4 c.f.s./acre.

$$.25^{C} \times 6784\,A \times 4 \times \sqrt[4]{\frac{25.000}{6784}}$$

$$\sqrt[4]{\frac{25}{6784}} = \sqrt[4]{.00368} \qquad \sqrt[4]{.0606} = .246$$

$$\frac{6784}{4} = 1696 \times 4 = 6784 \times .246 = 1670 \text{ c.f.s. Runoff.}$$

$$\frac{1670}{4} = 417 \text{ c.f.s. / 1" Rainfall.}$$

834	2"
1251	3"
1670	4"
2085	5"
2502 c.f.s.	6" chen country.

Water Resources Board Specify 5730 c.f.s. Run off

.204 = max Rate for 5 minute duration, 50 year frequency, = .60 x 12 = 7.2"/hr rate.

RATIONAL

Q = A.I.R.

Hogan Lake

6784 A x 25% x 6"/hr. = 2540

APPENDIX B

SECTION B3

COPIES OF PAST INSPECTION REPORTS AND DATA

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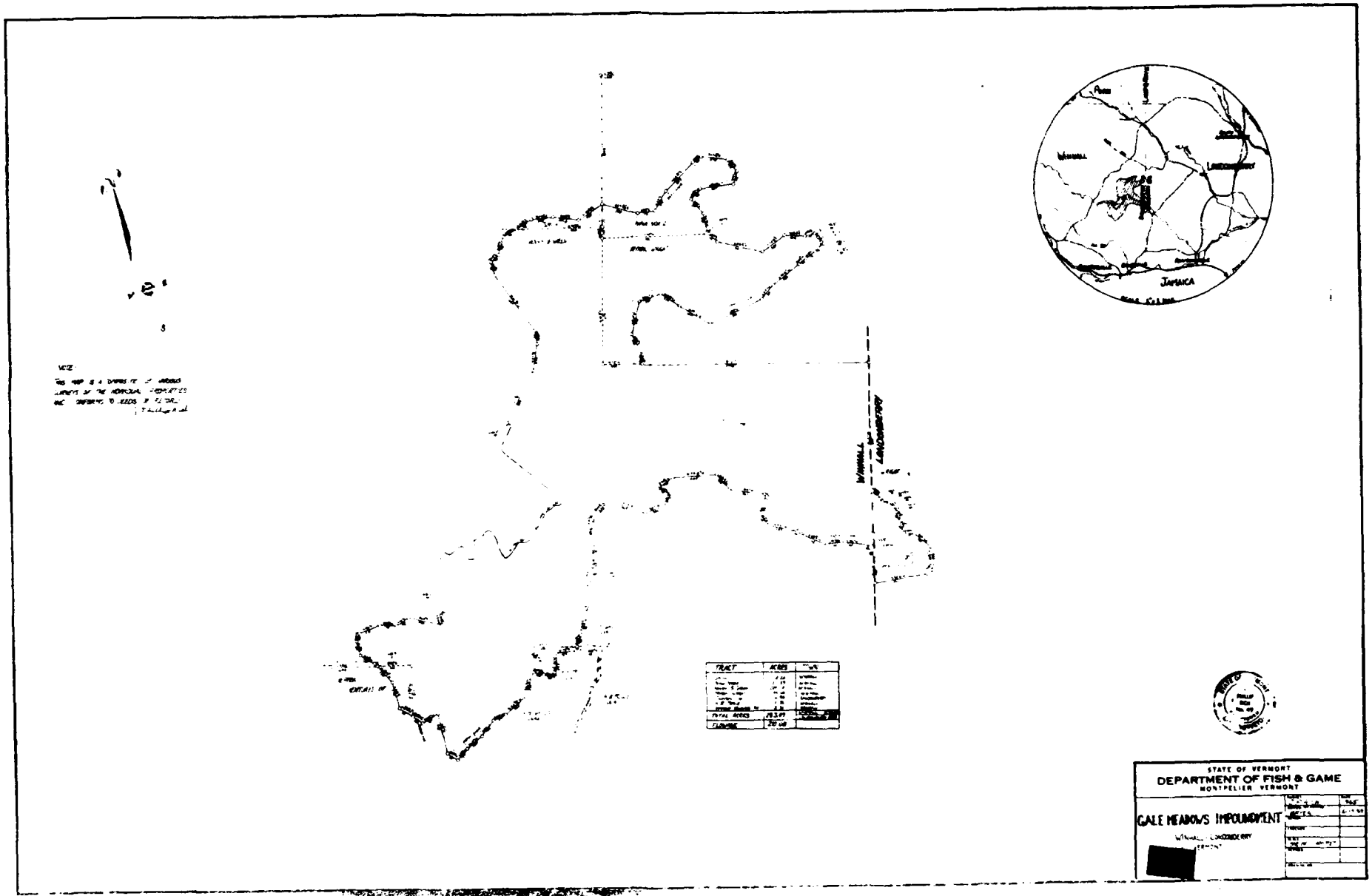
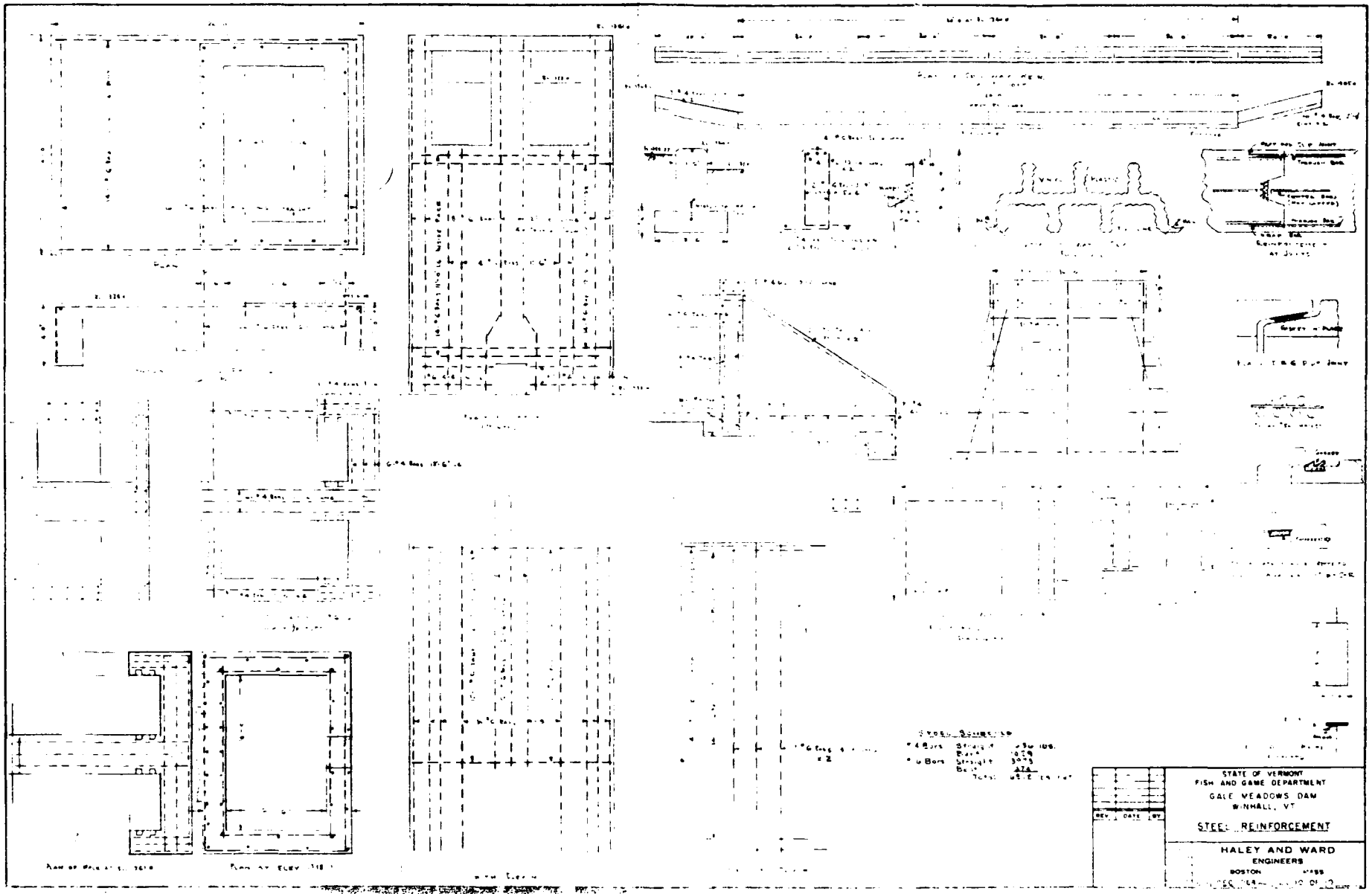
	Page
Design Calculations from Haley and Ward - October & November, 1962	B3-1
Contract and Specifications - December 1964(1)	B3-8
Application for Construction Permit for Dam - December 1964	B3-27
Hearing on Construction of Dam - January 29, 1965	B3-28
Construction Photographs(2) - 1965	B3-29
Bathymetric Map of Pond - August 1969	B3-31
Inspection Report by Donald H. Spies - November 17, 1972	B3-32
Inspection Report by Donald H. Spies - September 29, 1975	B3-33
Inspection Report by Donald H. Spies - August 23, 1976	B3-34
Damage Survey Report on Dam - September 14, 1976	B3-36
Inspection Report by Donald H. Spies - July 13, 1977	B3-39
Note and Sketches on Trash Rack Improvements - October 1977	B3-40
Memo on Spillway Inspections by Donald H. Spies - October 31, 1977	B3-46
Inspection Report by A. Peter Barranco, Jr. - May 22, 1979	B3-48

(1) Only the relevant portion of this document has been included.

(2) Only selected construction photos were included. Others are available at Haley and Ward Engineers, Inc.

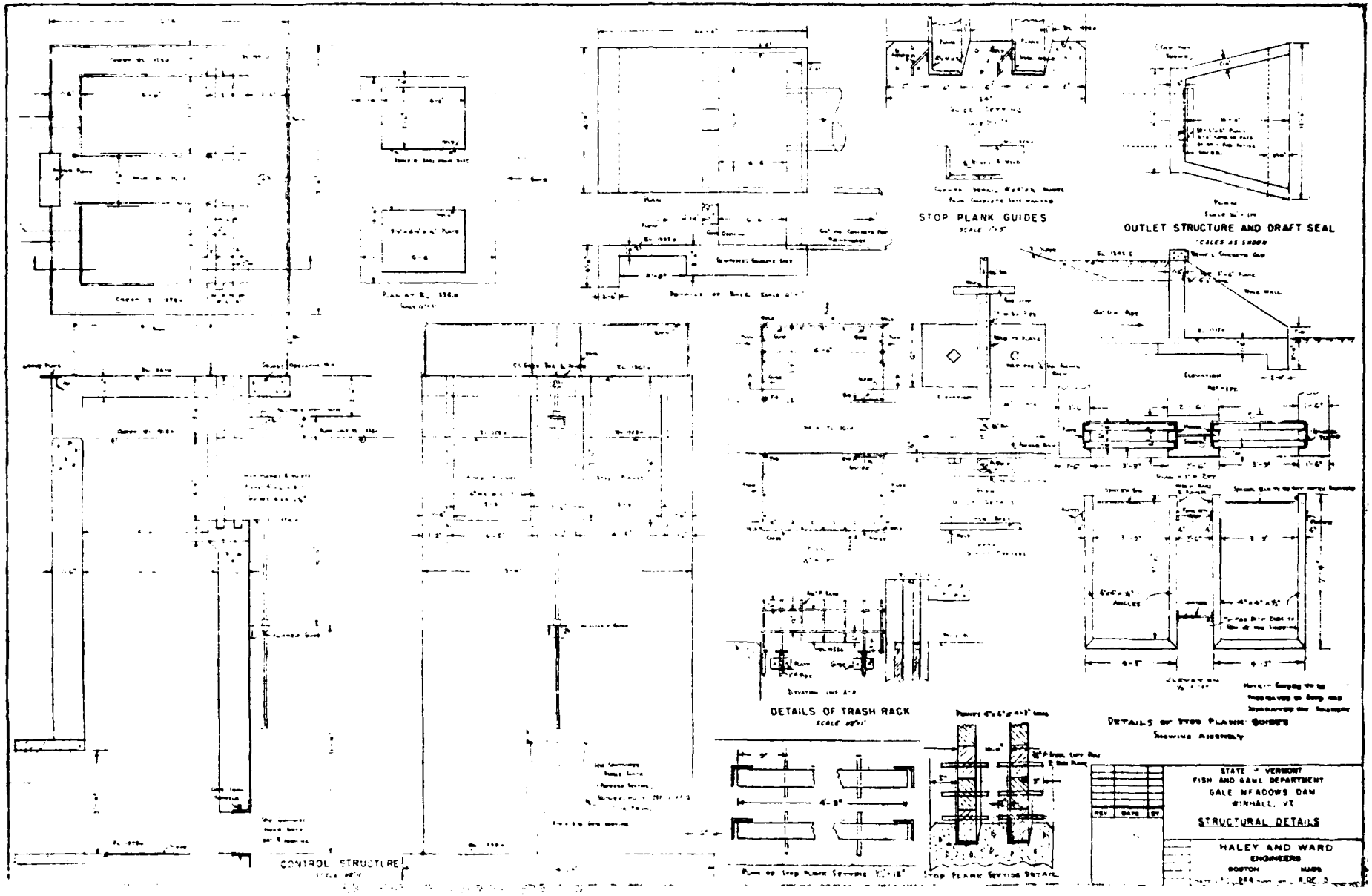

Jamaica
WINHALL
LONDONDERRY
STATE OF VERMONT
DEPARTMENT OF FISH & GAME
MONTPELIER VERMONT
GALE MEADOWS IMPOUNDMENT

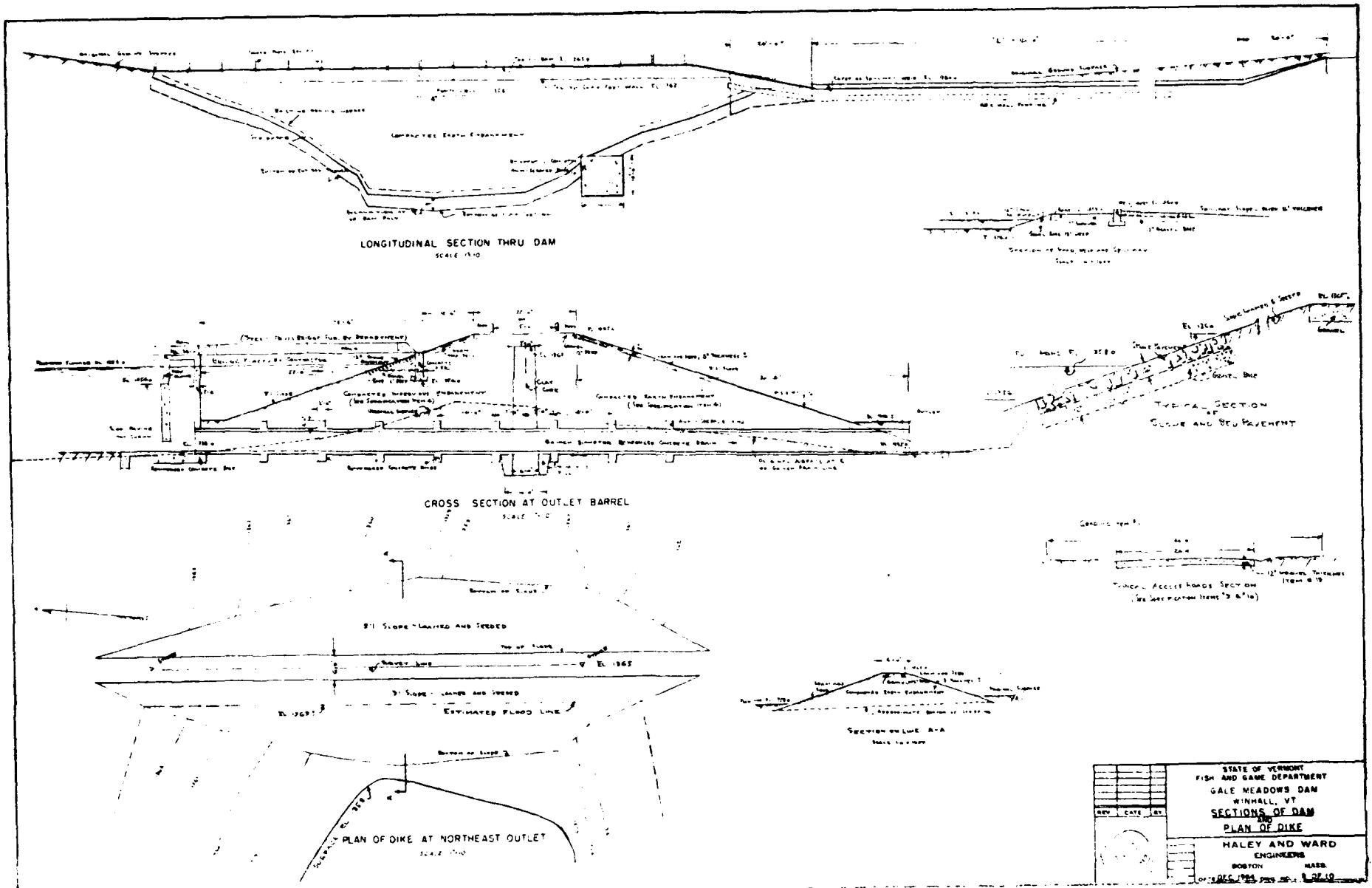


STATE OF VERMONT
FISH AND GAME DEPARTMENT
GALE MEADOWS DAM
WINHALL, VT

STEEL REINFORCEMENT

HALEY AND WARD
ENGINEERS
BOSTON MASS

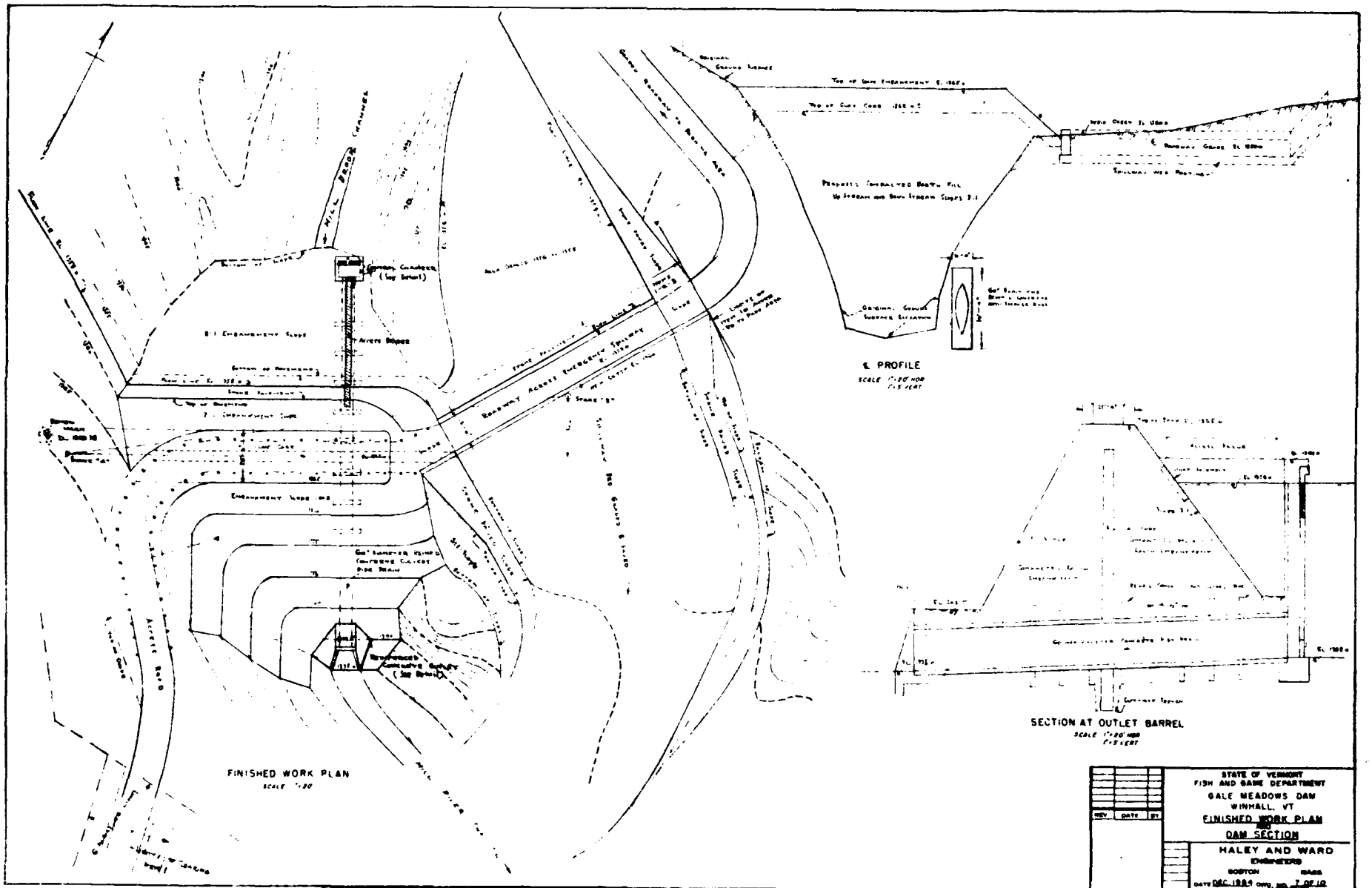

STOP PLANK GUIDES
OUTLET STRUCTURE AND DRAFT SEAL
DETAILS OF TRASH RACK
CONTROL STRUCTURE
STATE OF VERMONT
FISH AND GAME DEPARTMENT
GALE MEADOWS DAM
WINHALL, VT
STRUCTURAL DETAILS
HALEY AND WARD
ENGINEERS

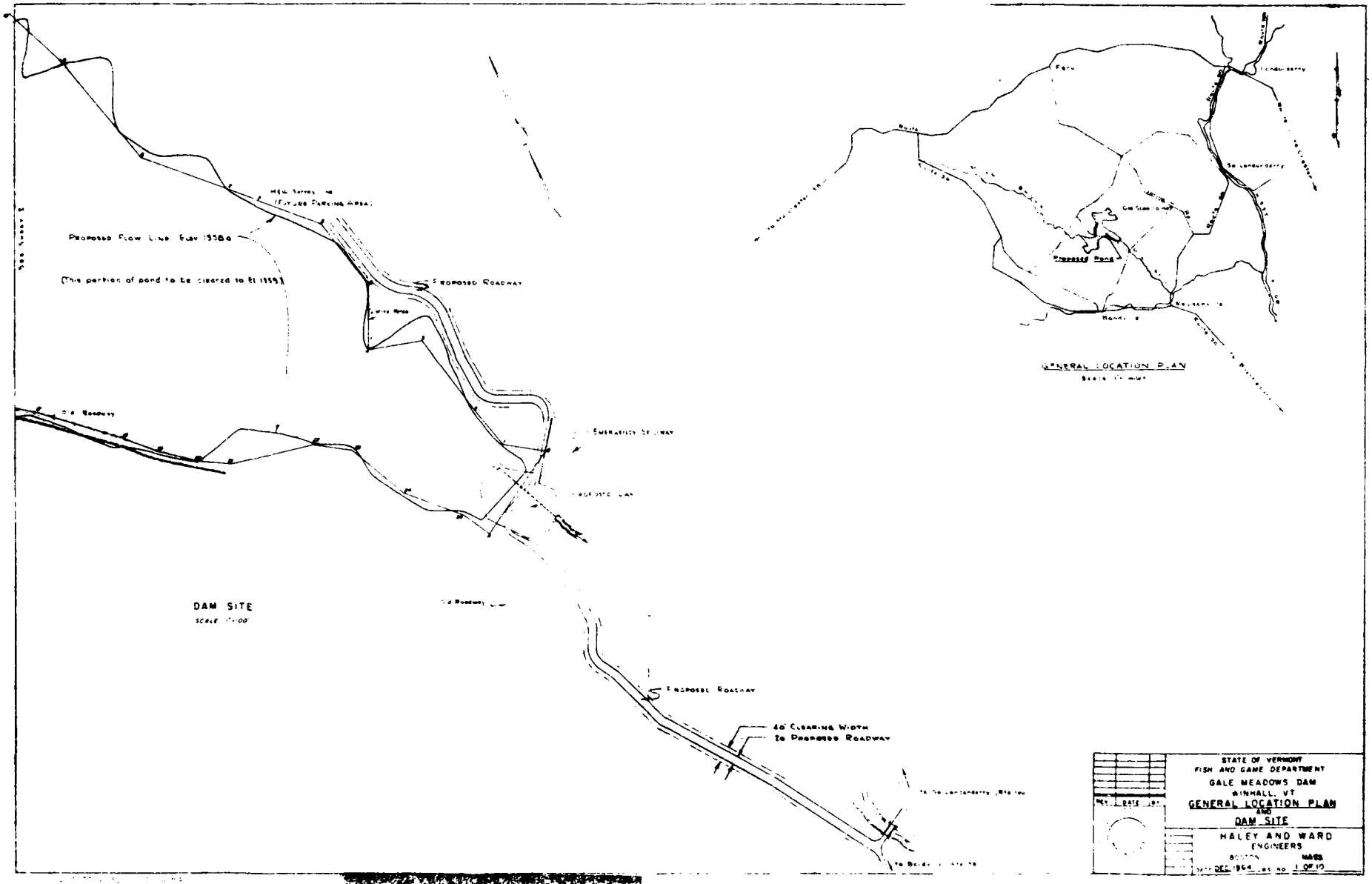


STATE OF VERMONT
FISH AND GAME DEPARTMENT
GALE MEADOWS DAM
WINHALL, VT
SECTIONS OF DAM
AND
PLAN OF DIKE

HALEY AND WARD
ENGINEERS
BOSTON MASS.

DEC 1984


FINISHED WORK PLAN
SCALE 1"=20'
℄ PROFILE
SECTION AT OUTLET BARREL
STATE OF VERMONT
FISH AND GAME DEPARTMENT
GALE MEADOWS DAM
WINHALL, VT
FINISHED WORK PLAN
AND
DAM SECTION
HALEY AND WARD
ENGINEERS
BOSTON MASS
DATE DEC 1984 DWG. NO. 7 OF 10



STATE OF VERMONT
FISH AND GAME DEPARTMENT
GALE MEADOWS DAM
WINHALL, VT
GENERAL LOCATION PLAN
AND
DAM SITE
HALEY AND WARD
ENGINEERS
DEC. 1964 SHEET NO. 1 OF 10

Plans Filed A (1)
in plan file.

STATE OF VERMONT

FISH AND GAME DEPARTMENT

CONTRACT AND SPECIFICATIONS

for the

GALE MEADOWS DAM
and
ACCESS ROADS

in

WINHALL VERMONT

CONTRACT NO. 11

DECEMBER 1961

George L. Wright
Quincy L. Terry

Joseph Wiltshire
Donald H. McNally

George H. Plumb, Chairman
BOARD MEMBERS

George W. Davis, Commissioner

Roger L. Semmens
Federal Aid Coordinator

MAINI AND WARD
CONSULTING ENGINEERS

Item No.	Description	Estimated Quantity	Unit	Bid Price	Estimated Amount
1	Clearing	90	Acre	$_____	$_____
2	Earth Excavation	4,000	cu. yd.	$_____	$_____
3	Rock Excavation	200	cu. yd.	$_____	$_____
4	Earth Embankment	13,000	cu. yd.	$_____	$_____
5	Clay Core Wall	600	cu. yd.	$_____	$_____
6	Concrete Masonry	240	cu. yd.	$_____	$_____
7	Steel Reinforcement	7,000	Pound	$_____	$_____
8	Control of Stream Flow	-	Lump Sum		$_____
9	Access Road	-	Lump Sum		$_____
10	Road to Parking Area	-	Lump Sum		$_____
11	60-inch Concrete Pipe	173	Foot	$_____	$_____
12	Placing Access Bridge	-	Lump Sum		$_____
13	24" x 24" Sluice Gate	-	Lump Sum		$_____
14	Steel Splash Plates	-	Lump Sum		$_____
15	Stop Plank Guides	-	Lump Sum		$_____
16	Stop Planks	-	Lump Sum		$_____
17	Trash Rack	-	Lump Sum		$_____
18	Pipe Railing	-	Lump Sum		$_____
19	Road Gravel	1,250	cu. yd.	$_____	$_____
20	Cedar Posts	60	Each	$_____	$_____
21	Stone Pavement	2,000	sq. yd.	$_____	$_____
22	Loam and Seeding	0.35	Acre	$_____	$_____

ESTIMATED TOTAL (Not a Lump Sum Bid) - $_____

This Proposal is accompanied by a Certified Check in the amount of $3,500.00 and the undersigned agrees that if this Proposal is accepted and he fails to execute a contract in accordance with the terms herein stipulated, the Proposal shall be null and void and the amount of the bid security shall be forfeited to the State of Vermont; otherwise the full amount of the bid security will be refunded to the bidder.

The bidder proposes to complete the construction within _____ months from the date of the signing of the contract document by the awarding authority.

SPECIFICATIONS

Section 0.1 The work to be done by the Contractor under this contract and in accordance with these specifications includes the furnishing of all labor and all materials and all tools and equipment required to complete the construction described in the Notice to Bidders and as detailed on the contract drawings and stipulated in the following specifications and including a compacted earth fill dam and all appurtenances shown on the contract drawings and as hereinafter specified and at the unit and lump sum prices stipulated in ARTICLE XXVIII.

Section 0.2 The Contractor shall provide all labor, superintendence, materials (except as otherwise specified), plant, tools and equipment necessary or desirable for properly performing and completing within the time stipulated, the work as above described and hereinafter more particularly specified. He shall furnish, erect, maintain and remove the construction plant and such temporary works as may be required. These requirements include suitable quarters for men and equipment wherever it may be necessary to provide such in the vicinity of the work, and the sanitary regulation of the same; water supplies for men, equipment, and for construction purposes temporary roads, together with bridges, guards, lights and signposts. He shall make provision for temporary storage of such materials and equipment as in the opinion of the Engineer may be necessary. In brief, the Contractor shall furnish and do everything necessary to complete the work in accordance with the terms of this contract and the requirements thereunder.

Section 0.3 The work to be done under this contract is shown on a set of contract drawings, reproductions of which are furnished for bidding purposes and additional copies of which will be available during construction.

Section 0.4 The Contractor shall check all dimensions and quantities on the drawings or schedules given to him by the Engineer, and shall notify the Engineer of all errors therein which he may discover by such examination and checking. He shall not take advantage of any error or omission in these specifications, or in the drawings or schedules, and full instructions will be furnished by the Engineer whenever such error or omission is discovered, and the Contractor shall carry out such instructions as if originally specified and for the unit and lump sum prices bid.

Section 0.5 All materials, fixtures, fittings and supplies furnished under this contract, unless otherwise specified, shall be of standard first grade quality and of the best workmanship and design.

Where the characteristics of any materials are not particularly specified, such approved materials shall be used as are customary in first-class work of the nature for which the material is employed. No inferior low grade articles will be either approved or accepted, and all work of assembly and construction must be done in a neat, first-class and workmanlike manner.

Any required physical tests will be made by the Department and the Contractor shall furnish such samples and test places as may be required. Tests will be made in accordance with the standard methods adopted by the American Society for Testing Materials for the materials involved.

Section 0.6 Sanitary convenience, properly screened from public observation, for the use of all persons employed on the work and beginning with the first men engaged in preliminary operations shall be provided and maintained by the Contractor in sufficient numbers, in such manner and at such locations as shall be approved.

Section 0.7 On or before the completion of the work the Contractor, except as otherwise expressly directed or permitted in writing, shall tear down and remove all temporary structures built by him; shall remove all surplus materials and all rubbish of all kinds from all contract structures and from any grounds which he may have occupied within the limits of the ownership of the Service. The Contractor shall remove all concrete and ballast droppings and shall leave the site of the work, and the adjacent property which may have been affected by his operations, in a neat and satisfactory condition.

Section 0.8 No direct payment to the Contractor shall be paid for providing tools or construction equipment and plant; nor for sanitary protection or for the final removal of plant and the clearing up of the site, but compensation for all such incidental work shall be considered as having been included in the unit prices and the lump sum prices bid.

CLEARING

Item 1

Section 1.0 Under this item the Contractor shall clear all areas shown on the contract drawings and as may be directed from time to time by the Engineer, including the access road in the old Town Road southerly from the steel bridge at Mill Brook in the direction of Bondville, the location of the access road to the dam site, the dam site, the access road to the proposed parking lot and the areas to be flooded, as shown in general outline on the contract drawings.

Section 1.2 Clearing of the proposed road locations shall include a strip forty (40) feet in width for the lengths specified. In road locations clearing shall include cutting of trees to stump height, removal of the trees and stumps and disposal by burning or otherwise as the Contractor may elect.

Clearing of the proposed dam site shall include the area to be occupied by the dam and accessory structures and the work to be done covers the cutting of trees to stump height, removal of the trees and stumps and disposal by burning or otherwise as the Contractor may elect.

Clearing of the area to be flooded and an additional one foot vertically above the proposed pond elevation of 1358 shall include the cutting of all trees to stump height, the disposal of all cut material by burning or otherwise and shall not require the grubbing of roots and stumps.

At the site of the proposed dike the clearing shall include the cutting and disposal of trees and the removal and disposal of stumps.

Section 1.3 Attention of the Contractor is directed to the provisions of Vermont State Laws pertaining to fires and burning in the open.

The statutes require that written permission be secured from the town fire warden for any and all burning operations.

The law provides penalties for leaving fires unattended. Fires must be either thoroughly wet down at quitting time or attended during the night.

Fire fighting equipment must be maintained on the job by the Contractor who shall familiarize himself and his employees with the requirements covered by law.

The Contractor shall reimburse the town for all labor costs in the suppressing of forest fires caused by his operations under this contract and settle with landowners for any damages caused by fires out of control.

Section 1.4 Payment for clearing will be made at the unit price bid per acre, the price to include all labor, tools and equipment.

The areas to be included for payment shall be estimated at forty (40) feet in width for the road locations, the actual area cleared at the sites of the proposed dam and dike and in estimating the area cleared for the pond only such individual areas as shown on the contract drawings and as may be specified from time to time by the Engineer will be paid for. It is not the intention to pay for the entire pond area to an elevation one foot above elevation 1358. Clearing paid for under this item shall include all trees and all substantial brush in areas shown on the contract drawing and as specified by the Engineer.

EARTH EXCAVATION

Item 2.

Section 2.1 The Contractor shall make all excavation in earth required for the dike, the dam and appurtenant structures including the emergency spillway.

Excavation shall include removing the top soil, roots and stumps at the dam and dike sites to a depth required to expose material suitable for foundation and acceptable to the Engineer; excavation shall include trenching for the cut-off trench, trench for culvert and structures and trenching for the emergency spillway weir wall and footing. Surface excavation for grading at the dam site will also be included in this item.

Section 2.2 Material suitable for surfacing embankments shall be kept separate for future use and material suitable for compacted embankment fill shall be made available or immediately placed as directed.

Section 2.3 Payment for excavation will be made at the cubic yard price bid for this item. Measurement of quantities will be made by the Engineer and calculations for the volume in surface excavation will include the difference between the original surface and the surface finally exposed for foundation material. Excavation for the cut off trench will be calculated as ten (10) feet in width for the actual length and the depth shall be estimated from the surface exposed for foundation to the actual bottom of the trench as determined by the Engineer.

Section 2.4 Earth excavation in the trench for the drainage culvert will be estimated for payment on the basis of a width of eight feet and for a depth from the bottom of the stripping to the invert grades shown on the contract drawings, except where excavation below grade is ordered specifically by the Engineer.

Excavation for the trench to contain the reinforced concrete waste weir shall be estimated for payment on the basis of a width of four feet and for the actual depth removed below finished grade.

All other excavation will be measured and estimated for payment on the basis of the actual number of cubic yards of material measured in place, as determined by the Engineer.

No allowance will be made under this item for excavation in borrow pits for material required to make the compacted earth embankment or for the clay core or for any other purpose except as herein specifically designated.

Section 2.5 The backfilling of trenches excavated for the several structures shall be done with the best of the excavated material or with suitable material from other parts of the work or from borrow, as the Engineer may direct from time to time. Backfilling shall be placed in layers not in excess of six (6) inch thickness, and particularly around the 60" culvert pipe and appurtenances the material shall be compacted by hand tampers or air operated tamping equipment. In backfilling around structures particular care must be exercised to protect the structure from damage and displacement of line and grade. Where the backfilling contacts original material a bond must be developed which will prevent the seepage of water along the line of cleavage. All structures must be placed on a foundation acceptable to the Engineer and the Contractor shall excavate to such depths as may be required to meet this condition; where refilling is required and where in the opinion of the Engineer, earth or bank gravel would not be suitable, the fill below grade shall be made with concrete which will be paid for at the unit price bid for concrete.

ROCK EXCAVATION

Item 3.

Section 3.1 The Contractor shall make all excavation in rock where ordered by the Engineer. Where ledge rock is encountered and boulders in excess of one half cubic yard in volume are present in the excavation herein specified, the Contractor shall follow the instruction of the Engineer relative to removal. In general the use of explosives is to be avoided where foundation conditions could be disturbed

Rock excavation to be estimated for payment by the Engineer shall include all ledge rock and all boulders one half cubic yard in volume and larger. All rock is to be measured in place by the Engineer.

EMBANKMENT

Item 4.

Section 4.1 The Contractor shall furnish and place all earth filling material required to construct the compacted earth embankment to form the proposed dam. The work to be done shall include the furnishing and operation of all equipment, tools, and all labor incidental to the satisfactory completion of the dam. The Contractor at his expense shall locate acceptable borrow pits either inside or outside the limits of property controlled by the Owner. Payment for material from borrow pits located outside the State controlled property shall be made by the Contractor and the cost included in the unit price bid for this item.

Section 4.2 It is the intention to construct the proposed embankment from acceptable materials obtained from borrow pits. Approval of the Engineer must be obtained from time to time as the work progresses and previous to delivery of the material at the site of the work, the cost of excavation, loading, hauling and placing the material is to be included in the unit price bid for this item.

Section 4.3 The material for the proposed embankment, except for the clay core shall be a mixture of clays, silts, sands and gravel, available from borrow pits in the vicinity of the work. Materials in which the clay content exceeds the voids in the sand and gravel shall in general be used for the impervious, upstream section of the embankment. The most satisfactory results can be had from materials having not less than 50 per cent by weight of particles larger than 0.20 millimeters in diameter and having no unnatural or unusual characteristics. Satisfactory material shall be graded from coarse to fine, the fine particles to be usually clay and be present in about 20 per cent of the volume by weight. It is to be particularly noted that soil made up of very uniform particles, either coarse or fine, will not be acceptable.

Section 4.4 The Contractor may be required to process the material at the borrow pit to effect a blended mixture suitable for placement in the embankment. Moisture content is most important in providing a material which will develop under compaction a satisfactory embankment structure and the Contractor may be required to arrange for the addition of water at the borrow pit or at the site, or if necessary at both places. In the event of the presence of excess water in the embankment material the Contractor shall provide harrowing equipment at the site to condition the delivered material and to rework deposited material after exposure to rain.

Section 4.5 No material shall be placed in the earthfill portion of the embankment until after the stream flow has been diverted and not until after the foundation has been unwatered and placed in an acceptable condition for the placement of fill. No material shall be placed in the embankment when either the delivered material or the foundation or the previously deposited material or the abutments are frozen.

Section 4.6 After the foundation has been satisfactorily exposed by the excavation of all topsoil and unsuitable deposits, the Contractor shall furnish and place the embankment material. Roots, sods, organic matter and all stones in excess of 6 inches in diameter will not be permitted in the embankment and the suitability of material proposed for use in the work will be determined by the Engineer.

Section 4.7 All work shall be done within and to the lines and grades established by the Engineer and as shown on the Contract drawings. Stakes and other control points established by the Engineer shall be carefully preserved by the Contractor who shall furnish such assistance and materials for stakes and batters as the Engineer may from time to time require.

Section 4.8 The compacted earth fill for the embankment and for re-filling the cut off trench outside of the core wall shall be furnished and placed by the Contractor using acceptable materials from borrow pits. Embankment material shall be placed in substantially level layers for the full width and length of the section being worked on. Material shall be placed in such quantities as will result in a 6 inch thickness after compaction.

Section 4.9 The distribution of the deposited material shall be such that after compaction the earth fill portions of the dam shall be free of lenses, pockets, streaks and layers of material substantially different in texture, gradation and density from the surrounding material. Filling material for the embankment must be placed at uniform elevation on each side of the clay core, the surface shall slope from the sides of the core to the outside edges of the embankment to provide drainage from anticipated rains. Compaction at edges of the embankment shall extend beyond the finish lines of the embankment to permit trimming to the finish surface and provide compacted material to the edges. Trimmed material can be used in the subsequent construction of the embankment.

Section 4.10 Fill material containing less than 10 percent to be retained on a #4 sieve shall be compacted so that the unit dry weight of the compacted material including the fraction larger than passing the #4 sieve is equal to or greater than 95 per cent of the maximum unit dry weight of material compacted under laboratory conditions to standard AASHO compaction specifications.

Fill material containing more than 10 per cent to be retained on a #4 sieve shall be compacted so that the unit dry weight of the compacted material including the fraction larger than the #4 sieve is equal to a greater than 95 per cent of the unit dry weight calculated by the Engineer.

Section 4.11 The Contractor shall spread the embankment material using equipment approved by the Engineer; as previously specified the level layers shall not exceed 6 inches thickness after compaction. Within practicable limits of inspection at the borrow pit it will be found that some materials arriving at the site will be coarser than others and this material shall be deposited in the downstream section and particularly at the outer edge; the finer and more impervious materials shall be placed adjacent to the clay core.

Section 4.12 The Contractor shall maintain on a full time basis during the progress of the embankment construction a full time crew of men in numbers approved by the Engineer, and available to closely follow the deposition of filling material to remove all roots, trash, debris and organic matter and all stones 6 inches in diameter and larger previous to compaction.

Section 4.13 After removal of all unsuitable materials and their disposal outside the limits of the embankment, the approved material shall be spread and rolled. Under conditions which in the opinion of the Engineer the adding of moisture is desirable for satisfactory compaction, the Contractor shall provide all labor and all equipment and follow closely the directions of the Engineer. Embankment material shall not be placed during weather conditions considered unfavorable by the Engineer.

Section 4.14 The award of this contract is based on the Contractor furnishing and operating equipment suitable in the opinion of the Engineer for producing the degree of earth embankment compaction herein specified. Considering the size and location of the proposed embankment it has been decided as impracticable to specify heavy (50 ton) rubber tired rollers. Tamping rollers (sheepsfoot) are considered satisfactory and shall have staggered, uniformly spaced knobs. The projected face area of each knob and the number and spacing of the knobs shall be such that the total weight in pounds of the roller and ballast if distributed over the equivalent area of one row of knobs paralled to the axis shall be not less than 250 pounds per square inch.

Section 4.15 The material in each layer shall be compacted by rolling under most favorable moisture conditions and within practicable limits the moisture shall be uniformly distributed throughout the layer. The application of water, as previously specified, should be made at the borrow pits; sprinkling at the site will, however, be permitted subject to approval by the Engineer. Harrowing of material may be required to produce the necessary uniformity. Moisture content for materials having less than 10 per cent stone as retained on a #4 sieve will only be compacted when the water content of the less than #4 content is within the limits of 4 per cent less to 2 per cent greater than the most favorable. Moisture content for materials having more than 10 per cent stone retained on a #4 sieve will have the compaction performed as specified above unless in the opinion of the Engineer the specified densities cannot be obtained.

Section 4.16 With the conditions previously specified, each layer of material shall be compacted by passing the specified roller over the entire surface the number of times required to obtain 50 per cent coverage as determined by the size and spacing of the roller knobs and assuming that no part of the layer being compacted is covered by a roller knob more than once.

Section 4.17 For a 6 inch layer compacted with a sheepsfoot roller, satisfactory densities can usually be had with 6 to 12 passes when the moisture content of the soil is correct. Satisfactory compaction can usually be determined, provided the water content is not too high when the material in the layer being compacted is able to support the unit pressures exerted by the tamping feet as evidenced by the "walk out" or the lifting of the roller drum from the surface during the last few passes.

Section 4.18 The Contractor shall be responsible for leaving the condition of borrow pits in a satisfactory condition upon completion of the work. No borrow pit in the area to be flooded, upstream from the dam shall be less than 100 feet from the upstream toe of the embankment slope. Any borrow pits within property controlled by the Owner shall be left in a condition satisfactory to the Engineer. Previous to removing any materials from borrow pits which is to be used in embankment filling, all top soil and all materials not acceptable for embankment material must be removed from the surface of the pit.

Section 4.19 Payment for material used in compacted embankment filling will be made at the unit price bid for this item, the price to include the cost of all labor and all materials, the finding and development of borrow pits, the processing, hauling and placing of the material at the site, all compaction requirements including the furnishing and operation of equipment of every description and the trimming and shaping of the embankment to the lines and grades furnished and as shown on the contract drawings. The volume paid for will be the actual yardage as determined by the Engineer, measured in place in the finished embankment less the volume of the clay core wall.

CLAY CORE WALL

Item 5.

Section 5.0 The Contractor shall furnish the material for and place in the compacted embankment, a clay core wall as shown on the contract drawings, furnishing all labor and all materials, tools and equipment.

Section 5.1 Material for the clay core shall be a fine grained inorganic soil with cohesion enough when in a dry state to form hard lumps not readily broken by hand and being for the most part hydrous aluminum silicate derived as a product of chemical weathering. The material shall be plastic and when dry shall have approximately 80 per cent finer than .35 millimeters and about 10 per cent by weight finer than .035 millimeters.

Section 5.2 The Contractor must exercise particular care in the furnishing and placing of the clay core wall and a method of placing, approved by the Engineer shall be adopted at the beginning of the work and followed throughout the construction of the embankment.

Section 5.3 Payment for furnishing and placing the core material will be made on the basis of the number of cubic yards, measured in place by the Engineer within lines specified as six (6) feet in width at the base and five (5) feet in width at the top and a height based on the profile determined by the Engineer as the work progresses.

CONCRETE MASONRY

Item 6.

Section 6.0 Concrete shall be mixed in the approximate proportions of one part Portland Cement to six (6) parts of sand and coarse aggregate and shall be mixed and placed to insure dense water and weather resistant masonry.

Section 6.1 All cement used in the concrete masonry shall be Portland Cement manufactured by an established mill with a reputation and a brand designated and approved by the Engineer. Only one brand of cement will be accepted for the work and the cement must meet the standard specifications for American Portland Cement issued by the American Society for Testing Materials.

Section 6.2 All sand used for concrete masonry in the foundation structure shall be acceptable to the Engineer and must not contain in excess of three (3) per cent by weight of foreign matter removable by the elutriation test. All sand proposed for use in the concrete masonry shall be subject to colorometric tests in the field, made by, or in the presence of the Engineer.

Section 6.3 The stone or coarse aggregate furnished by the Contractor for the foundation masonry shall be crushed gravel or broken trap rock or granite, and shall be free from dust and any material detrimental in the opinion of the Engineer to the quality of the concrete masonry; not more than five (5) per cent by weight shall pass a 1/4 inch mesh screen and approximately five (5) per cent by weight shall be retained on a one (1) inch mesh screen.

Section 6.4 The concrete masonry shall be mixed at the site of the work in machine mixers of approved design, or with the approval of the Engineer, transit mixed concrete may be accepted. Mixing shall be continued until the cement is thoroughly distributed through the sand and stone and the consistency of the mixture shall be such that the concrete may be readily placed by spading or mechanical vibration, and necessary provisions shall be made for rapid handling to insure the concrete being placed in its final position before any initial set commences; thereafter the concrete shall be protected from too rapid drying and the exposed surfaces shall be covered with burlap and saturated with water for a period of not less than five (5) days after pouring.

Section 6.5 The concrete masonry shall be mixed in the proportions of 6.0 bags of cement, 1140 pounds of sand and 2110 pounds of coarse aggregate, which portions and the limiting of the water content to 5.6 gallons per bag of cement should result in concrete having a compressive strength of not less than 3,000 pounds in seven (7) days.

Section 6.6 The Contractor shall furnish and erect all required form work to contain the concrete masonry within the lines and grades furnished by the Engineer and to the form and dimensions shown on the contract drawings, and all form work shall include substantial bracing and ties to secure the forms against movement during the placing of the concrete, and the forms shall remain accurate to line and grade during and after the placing of the concrete masonry.

Section 6.7 All joints in the concrete masonry, where shown on the contract drawings or made necessary on account of construction procedure, shall be made and proved watertight. Horizontal joints shall include plastic water seal strips, one-half sealed in first pour and the remainder projecting into the succeeding pour.

Vertical joints shall be made with labyrinth water seal strips of corrugated vinyl plastic with 4 x 3 ribs as shown on the contract drawings. The side with the larger number of ribs is fastened to the form containing the first pour. After stripping of forms the exposed ribs make a leakproof bond between the succeeding pours.

Section 6.8 Concrete masonry furnished and placed under this item will be paid for by the cubic yard measured in place in the finished work by the Engineer and within the lines and grades shown on the contract drawings and established by the Engineer, the price to include the cost of all labor and all materials except the steel reinforcement.

STEEL REINFORCEMENT

Item 7.

Section 7.1 Steel reinforcement shall be round deformed bars of the diameter, shapes and dimensions shown on the contract drawings and shall meet the requirements of Specifications for Rail Steel Bars for Concrete Reinforcement, ASTM Designation A-16-50 T. Before placing any rods in the concrete they shall be cleaned and kept clean until the concrete is placed. The specified spacing shown on the drawings shall be followed carefully and all rods shall be held securely in place and movement during placing of concrete shall be prevented. All intersecting bars shall be wire tied.

Section 7.2 Steel reinforcement will be paid for at the unit price bid for this item. The Contractor's supplier's delivery schedules and weights will be checked by the Engineer and the weight of the steel actually used in the work will be estimated for payment.

CONTROL OF STREAM FLOW

Item 8.

Section 8.1 The Contractor shall under this item undertake such arrangements as may be necessary to control the flow in Mill Brook during the construction operations.

It is the intention to clear the dam site of trees and to excavate all top soil to expose material suitable for embankment foundation and to trench for the 60-inch outlet culvert and to lay the 60-inch culvert pipe; during this time the Mill Brook will follow its natural course.

Upon completion of the control chamber and before any compacted fill is placed, the Mill Brook flow shall be diverted to the 60-inch culvert. The Contractor shall furnish and place all materials required for dikes, coffer dams or other structures required to divert the brook water and to maintain the flow through the proposed 60-inch culvert.

Section 8.2 Payment for all labor and all materials will be made at the lump sum price bid for this item.

ACCESS, BONDVILLE ROAD TO DAM SITE

Item 9.

Section 9.1 The Contractor, under this item, shall construct an access road from the old Bondville town road near the steel bridge over Mill Brook to the proposed dam site as shown on the contract drawings.

Section 9.2 The work to be done includes clearing an area forty (40) feet in width to be paid for under another item, grading a roadway twenty (20) feet in width on the center line location shown on the contract drawings and furnishing and placing a gravel surface 20 feet in width graded to the approximate contour of the existing ground and to the elevation shown on the contract drawings. The gravel to be paid for under another item.

Section 9.3 The Contractor shall furnish and place corrugated metal, tar coated culvert pipe at the locations shown on the contract drawings and at such other locations found necessary as the work progresses.

Section 9.4 The work to be done under this item will be paid for as a lump sum, the price bid to include all labor and all materials except clearing and the furnishing and placing of the gravel surface.

ROAD FROM DAM TO PARKING AREA

Item 10.

Section 10.1 The Contractor under this item shall construct a roadway from the dam site to the proposed location of a parking lot to be constructed by others, northwesterly from the northerly end of the dam, as shown on the contract drawings.

Section 10.2 The work to be done includes clearing an area 40 feet in width to be paid for under another item, grading a roadway 20 feet in width on the center line location shown on the contract drawings and furnishing and placing a gravel surface 20 feet in width graded to the approximate contours of the existing ground and to the elevations shown on the contract drawings. The gravel to be paid for under another item.

Section 10.3 The Contractor shall furnish and place corrugated metal, tar coated culvert pipe at the locations shown on the contract drawings and at such other locations found necessary as the work progresses.

Section 10.4 The work to be done under this item will be paid for as a lump sum, the price to include all labor and all materials except clearing and the furnishing and placing of gravel surface.

60 INCH CONCRETE CULVERT PIPE

Item 11.

Section 11.1 The Contractor shall furnish and install complete and to the line and grades shown on the contract drawings about 173 linear feet of sixty (60) inch inside diameter reinforced concrete culvert type pipe for the drainage outlet through the dam; the pipe shall be installed complete with flexible joints, reinforced concrete anti seepage rings, all as shown on the contract drawings.

The concrete pipe shall be equal to American Society for Testing Materials standards, shall be 6 inch minimum shell thickness and shall resist satisfactorily an ultimate load of 10,000 pounds per linear foot on the basis of three-edge-bearing method.

Section 11.2 The pipe shall be manufactured with tongue and groove ends of such design that when laid the result will be a continuous smooth and uniform interior surface. Pipe joints shall be of a form to make possible the use of flexible pre moulded material, such as "Tylox" as manufactured by Hamilton-Kent. No cement or other type of rigid material and no poured jointing material will be approved for use.

Section 11.3 The Contractor shall take particular care in laying the culvert pipe. The invert of the pipe must be supported on undisturbed original ground for its entire length. Excavation of the trench bottom must follow the finished grade of the bottom of the pipe and any excavation below grade except for the anti seepage rings and where ordered by the Engineer shall be replaced with concrete at the Contractor's expense.

Section 11.4 Backfilling must be accomplished with special care. Selected material must be used and placed in thin layers thoroughly compacted under and around the pipe and against the sides of the trench,

Section 11.5 To prevent seepage along the culvert pipe the Contractor shall construct antiseepage rings of reinforced concrete as shown on the contract drawings. The concrete must be completely bonded to the pipe and rough lumber should be used for forms to develop maximum resistance to any possible water travel. The forms must be removed before embankment filling progresses.

Section 11.6 Payment for the pipe culvert will be made at the unit price bid per linear foot, the price to include all labor and all materials except the reinforced concrete antiseepage rings which will be paid for at the unit prices bid for concrete masonry and reinforcing steel.

PLACING ACCESS BRIDGE

Item 12.

Section 12.1 The Contractor shall furnish all labor and equipment required to set the steel truss access bridge as shown on the contract drawings and extending from the concrete pier in the embankment slope to the control chamber.

Section 12.2 The bridge will be furnished at the site of the work by the owner, the bridge frame is approximately 2' - 6" wide and 52' - 0" in length, and the Contractor shall verify these dimensions before installing the pier and control chamber.

Section 12.3 Payment for setting the access bridge will be made at the lump sum price bid for this item, the price to include the cost of all labor, tools and equipment except the bridge unit.

24 INCH x 24 INCH SLUICE GATE

Item 13.

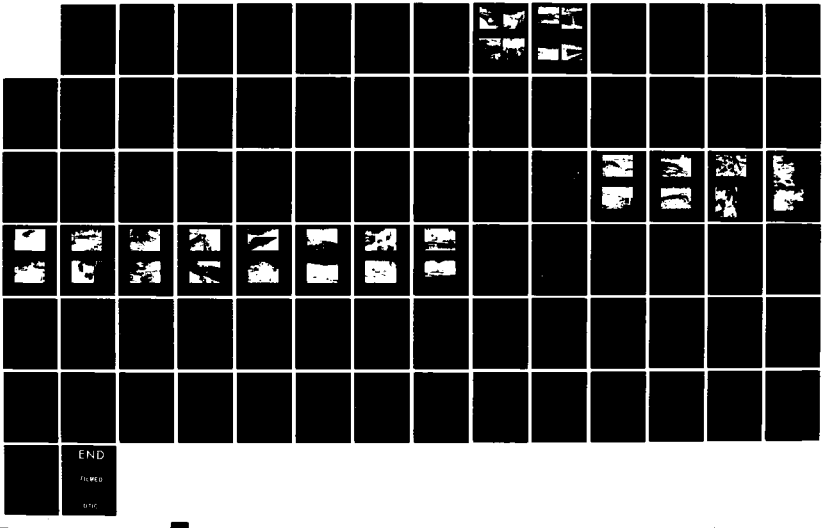
Section 13.1 The Contractor shall furnish and install complete the 24" x 24" sluice gate, gate operating stem, guide brackets and cast iron frame and cover enclosing the gate operating nut, all as shown on the contract drawings.

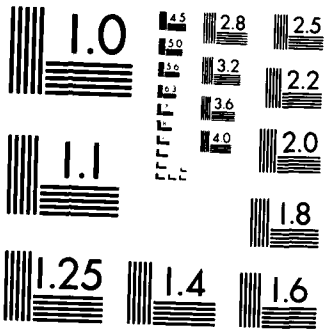
Section 13.2 The sluice gate shall be self contained, have a 24 inch square opening, be cast iron, bronze mounted of the 200 series as manufactured by Rodney Hunt, Orange, Mass., with adjustable wedge system for water tightness under the anticipated seating pressures.

The gate shall be furnished with a cast iron type "F" thimble 24" x 24" square opening, together with operating stem, to be contained within a distance of 23 feet from invert of the gate to the upper surface of the operating platform. The stem shall be furnished with two sets of adjustable stem guides complete with bolts and wall brackets. The upper end of the gate stem shall terminate in a square operating nut and the stem and nut shall be enclosed in a cast iron "gate box type" frame and cover, all as shown on the contract drawings.

AD-A156 013 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
GALE MEADOWS DAM (VT.. (U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV MAR 80 3/3

UNCLASSIFIED F/G 13/13 NL





STOP PLANKS

Item 16.

Section 16.1 The Contractor shall furnish and install wooden stop planks as shown on the contract drawings. Two complete sets of planks shall be installed and all planks shall be straight, free from knots and other imperfections and shall be planed two sides and both edges to insure tight joints between the guides and each adjoining plank. Ends shall be square, the planks shall be of uniform length and 1-1/2 inches shorter than the space between the guides.

Section 16.2 Lumber for guides shall be fir or an approved equal, cut to dimensions and then pressure treated; full seal creosote treatment at a rate of 16 pounds per cubic foot will be required.

Section 16.3 Each stop plank shall be fitted with two steel lift pins, 3/4 inch diameter and about 9 inches in length, spaced as shown on the contract drawings, holes for the lift pins shall be drilled before the planks are creosoted and one face shall be countersunk to permit driving the pins without splitting the surface.

Section 16.4 Payment for furnishing, delivering and setting the wooden stop planks will be made at the lump sum price bid for this item, the price to include all labor and all materials including pressure creosote treatment.

TRASH RACK

Item 17.

Section 17.1 The Contractor shall furnish and install complete, the two sets of trash rack bars and brackets as shown in detail on the contract drawings.

Section 17.2 The rack shall be fabricated by welding 3/4 inch diameter steel bars in the form and dimension shown on the contract drawing, making provision for brackets to be attached to the inside face of the structure walls as shown.

Section 17.3 The rack and brackets shall be painted one coat of red lead followed by two coats of black asphalt enamel.

Section 17.4 Payment for furnishing, delivering and installing the trash rack and brackets will be made at the lump sum price for this item, the price to include the cost of all labor and all materials.

PIPE RAILING

Item 18.

Section 18.1 The Contractor shall furnish and install complete, the pipe railing at the Control Chamber as shown on the contract drawings.

Section 18.2 The railing shall include galvanized steel pipe posts, rails and shall be complete with base flanges, bolts and fittings. Posts shall be 2-1/2 inch standard steel pipe galvanized, railings shall be 1-1/2 inch standard steel

pipe, galvanized and shall have either screw or welded attachment to fittings and posts.

Section 18.3 Base flanges shall be attached to concrete using expansion shield and bolts, flanges shall be set in mastic to prevent water entering under flange and into shields.

Section 18.4 Payment for furnishing, delivering and erecting the pipe railing will be made at the lump sum price bid for this item and the price shall include all labor and all materials including one coat of red lead primer and two coats of black asphalt varnish paint.

ROAD GRAVEL

Item 19.

Section 19.1 The Contractor shall furnish and place as directed and as shown on the plans and specifications, all run of the bank gravel for a base under stone pavement and for the road surface across the embankment and on the ramps and roadway at the waste weir.

Section 19.2 Gravel shall be clean, free from organic matter and from stones larger than three inches in diameter. For the gravel used in the road, a clay content to provide binding would be desirable, and the road gravel shall be placed in an excavated trench in the compacted embankment and then graded and rolled.

Section 19.3 Across the waste weir section the gravel is to be placed as a wearing surface over the stone fill deposited to prevent erosion, the gravel to fill the voids in the stone and to provide a readily maintained grade.

Section 19.4 Gravel for the roadway shall include some clay fines to insure a binder. Gravel for the base of stone pavement and rock fill shall be free of organic matter, loam and topsoil and shall be free draining.

Section 19.5 Payment for furnishing, delivering, placing and grading road gravel will be paid for at the unit price bid for this item, the price to include all labor, all material and equipment to provide the gravel in access roads, at the dam and as may be directed by the Engineer.

CEDAR POSTS

Item 20.

Section 20.1 The Contractor shall furnish and set all cedar guard posts shown on the contract drawings and as may be directed from time to time by the Engineer.

Section 20.2 Posts shall be seasoned cedar, locust or spruce, meeting State Highway standard specifications. Posts shall be not less than 6-inch diameter at the small end after removal of bark. Posts shall be shaved to to an even surface and not less than 5' - 6" in length.

Section 20.3 All posts shall be given full pressure preservative treatment with creosote, pentachlorophenol solution or salt solution as per Vermont State Highway specifications, using the empty cell process and the volume of retention and method of treatment shall meet Federal Specifications TT-W-571d as amended.

Section 20.4 Payment will be made at the unit price bid for this item and shall include the cost of all labor and all materials required for furnishing, delivering and setting the posts as specified, including pressure treatment.

STONE PAVEMENT

Item 21.

Section 21.1 The Contractor shall furnish and place stone pavement for the protection of the embankment at the water line on the upstream slope of the main dam and upstream and downstream from the concrete weir wall in the emergency spillway and on the slopes at the inlet and outlet end of the drainage culvert and otherwise as shown on the contract drawings, including the toe of the downstream slope.

Section 21.2 All stone shall be hard and durable to provide protection from alternate freezing and thawing. Stone at the waste weir shall be similar to local wall stone with sixty per cent of the area covered by stones weighing between 50 and 70 pounds, with smaller stones filling the voids.

For the embankment pavement (rip-rap above and below the proposed water line at elevation 1356) the pavement shall be furnished and placed as dumped rip-rap. Stone shall be typical New England wall stone with the voids well filled with smaller sized natural or broken stone and stone encountered in excavation may be used.

Section 21.3 All stone pavement shall be placed on a base of free draining run of the bank gravel. Pavement and base shall be placed to the lines and grades shown on the contract drawings.

It is the intention to place the stone and the gravel base in a trench excavated in the compacted embankment and any attempt to place the base and stone as the embankment is constructed will not be acceptable. It is not the intention to require hand placement of the rip rap but the pavement shall follow as closely as practicable the lines and grades shown on the drawings which must result in a workmanlike and acceptable operation.

Section 21.4 Payment for stone pavement will be made at the square yard unit price bid for this item and the price shall include all labor and all material except the gravel base which will be paid for under another item and includes the cubic yards actually furnished and placed to the lines and grades shown on the contract drawings and furnished by the Engineer from time to time.

LOAMING AND SEEDING

Item 22.

Section 22.1 The Contractor shall furnish and place all loam for surfacing the areas shown on the contract drawings and as may be designated from time to time during the progress of the work by the Engineer.

Section 22.2 Loam shall be acceptable material stripped from the site with the deficiency made up from Borrow. All loam shall be carefully placed to the lines and grades established and shall be raked and consolidated to the minimum thickness shown on the drawings.

All loamed slopes shall be seeded and afterwards tended to insure a vegetation protection against erosion of the embankment. The placing of loam will be included under a previous section, but the fertilizing required to insure a suitable growth of grass is to be done under this section. The surfaces to be seeded shall be carefully prepared by raking and rolling. All weeds, sticks, stones and other unsuitable material shall be removed and the loam is to be conditioned with an approved commercial fertilizer applied at the rate of not less than 400 pounds per acre.

Section 22.3 A mixture of grass seed similar to the following formula will be approved and the Contractor shall make allowances for the substitution of special seed found suitable for satisfactory use in the particular area by the Service.

For each area of one acre, 60 pounds of seed divided as follows shall be used:

Perennial Rye Grass	7 pounds
Orchard Grass	15 "
Hard Fescue	4 "
Kentucky Blue	6 "
Sheep Fescue	6 "
Timothy	7 "
Perennial Red Clover	4 "
White Clover	4 "
Red Top	7 "

Where seeding is done between the middle of June and the middle of September, about 15 pounds of oats per acre shall be added and when planting is permitted after September 15th, about 15 pounds per acre of winter rye shall be added.

Section 22.4 The Contractor shall take advantage of favorable weather and shall employ a method of sowing satisfactory to the Engineer. The seed shall be raked in and the whole surface then lightly rolled. Seeding shall be done immediately after the preparation of the earth surface unless otherwise directed. If there be any delay, and if weeds grow in and with the grass, he shall cut the weeds before they go to seed or at such time as directed by the Engineer. If any loam is washed away or any portions of the seeded areas are not covered by grass, he shall replace the loam, refertilize and reseed without additional compensation. Hay or straw mulching may be required to insure growth.

Section 22.5 Payment for loaming and seeding will be made at the unit price bid per acre of completed work as determined by the Engineer and shall include all labor and all materials, attendance and watering, weeding and care.

STATE OF VERMONT
WATER CONSERVATION BOARD
State Office Building
Montpelier, Vermont

APPLICATION FOR CONSTRUCTION PERMIT FOR DAM

Owner State of Vermont Fish & Game Dept. Date ____________

P. O. Address ____________
Montpelier Vermont Tel. No. ____________

Location of Structure:

Town Londonderry & Winhall Shown on USGS Quadrangle Londonderry

Name of Stream Mill Brook at ____ inches south/north of Lat. ____________
In Londonderry, 0.1 mile downstream of Winhall town line and ____ inches east/west of Long. ____________

Directions for reaching site from nearest village or route intersection:
(see sketch on reverse side)

This is an application for: (New Construction) x (Alteration) (Repair) (Removal)
(check one or more of above)

This pond is to be used for: Public Fishing Impoundment

Dimensions of Pond: width ________ length ________ area 200 acres

Maximum depth of water immediately above dam: 20'

Volume of water in cubic feet in excess of 500,000 cubic feet

Total length of dam: 155'

Length of spillway: 120' w/20' ramps on each side

Height of dam: 30'

Width of top: 25'

Width of base: 225'

Type of spillway construction: Concrete weir

Type of dam construction: Earth fill

Spillway section will be set on: (Bedrock) (Gravel) (Clay) (Till)
(check one of above)

Remarks: ____________

Signed: [signature] (owner)

Name of Engineer, if any ____________

Note #1: Enclose with this application the Plans & Specifications

Note #2: Enclose copy of letter of notice to selectmen of the town in which

B3-27

WCB #32

VERMONT WATER RESOURCES BOARD

Hearing on Construction or Reconstruction of Dams

Date January 29, 1965

Name of Dam or Impoundment - Gale Meadows Dam

Name of Petitioner - Vermont Department of Fish and Game

Location - Londonderry and Winhall

Stream - Mill Brook

Size of Drainage Area - 10.3 Square Miles

Quantity of water to be stored - in excess of 500,000 cubic feet

Surface Area of Impoundment - 200 acres

Type of Dam - Earth Fill

Brief Description of Project Explaining Its Size and Intended Use -
30' high dam -- 155' long
120' long emergency dam w/additional 20' ramps on each side
Also has 7' high dike -- 150' long at Northeast outlet

Description of downstream conditions, hazards, etc. -
Bridge on Londonderry Town Road #43 located about 1/4 mile downstream of dam. -- Vermont Route #8 is located about 1 3/4 miles downstream of dam.

Report of Staff -
Adequate to provide for the public safety

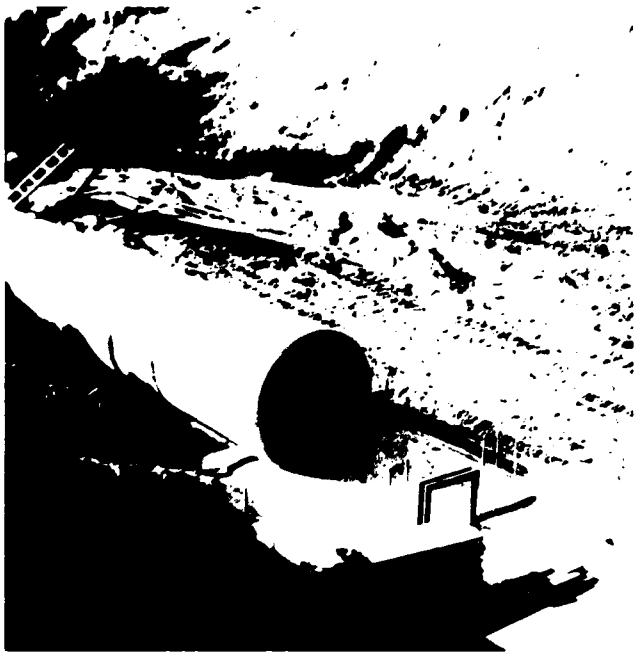
Determine Public Good by the Following:

(a) Consideration to quality, kind and extent of agricultural land that may be flooded. — None

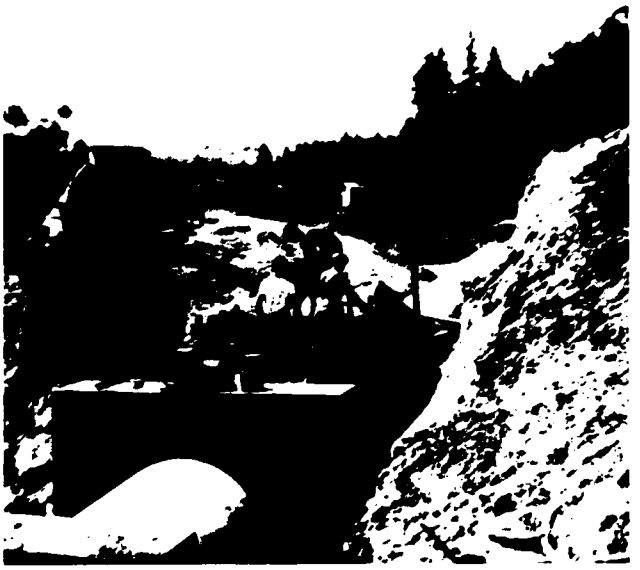
(b) Consideration to the effect of project upon:

1. Scenic and recreational values — Improve
2. Fish and wildlife — Purpose
3. Town Grand Lists and Revenues — Improve
4. Forest and forest programs — No material
5. Natural flow of water in the stream below the dam — None
6. Hazards to navigation, fishing, bathing and other public uses. None

(c) Investigate the question whether the cutting clean and removal of all timber and tree growth from all or any part of the flowage area is reasonably required. — Yes



Outlet conduit and foundation for inlet structure - 1965



Anti-seepage collars on outlet conduit, looking upstream - 1965

Emergency spillway weir looking upstream 1965

Emergency spillway weir looking toward left abutment - 1965

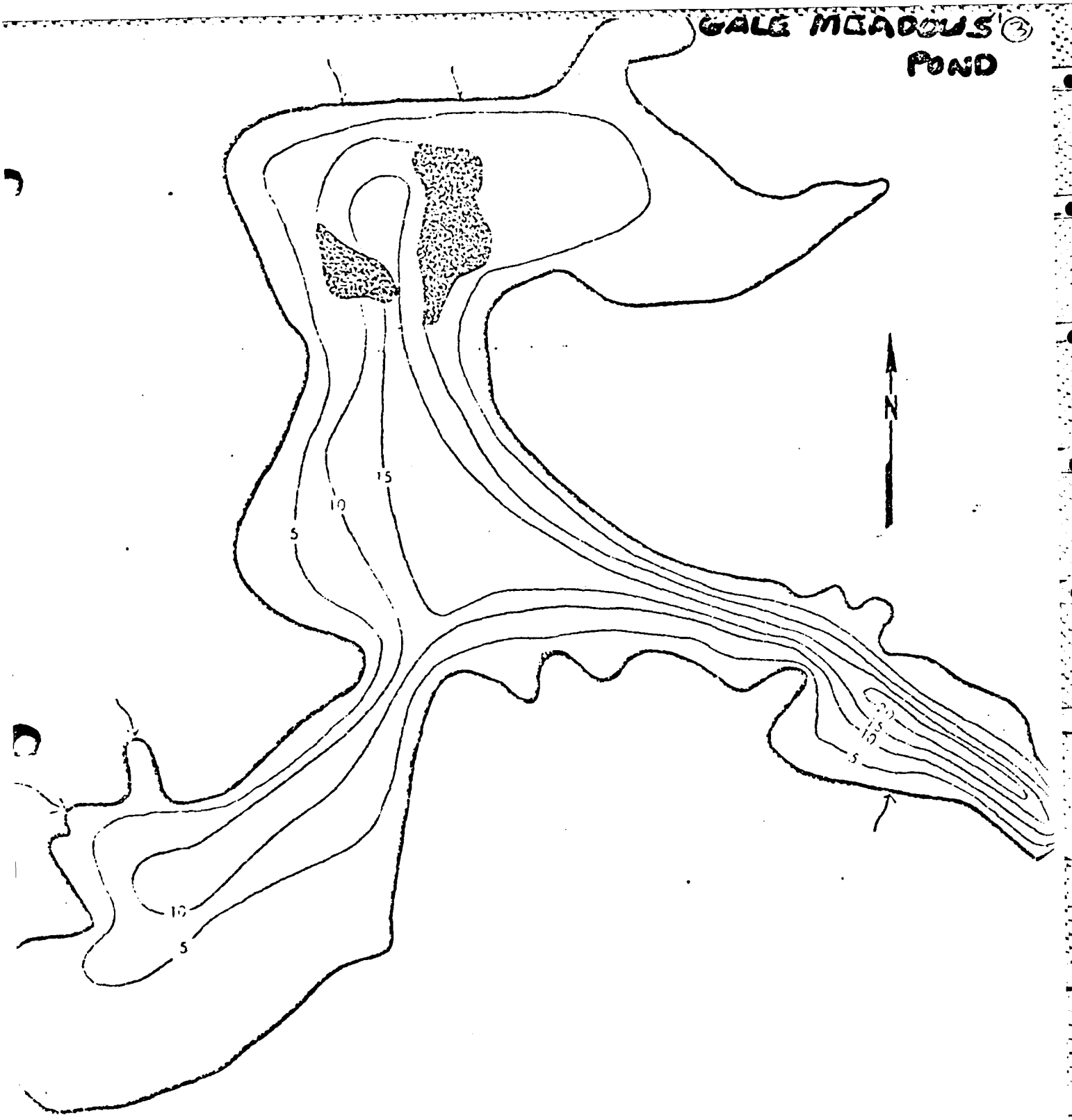
Outlet conduit foundation and dam looking toward left abutment -1965

Emergency spillway weir looking toward right abutment - 1965

Intake structure and upstream face of dam 1965

Downstream face of dam looking toward right abutment - 1965

GALE MEADOWS (3)
POND



ALE MEADOWS POND

DEPTH CHART
SCALE IN FEET
0 400 800

STATE OF VERMONT
FISH AND GAME DEPT.
AUG. 1969

Island

B3-31

FILE COPY

A (4)

AGENCY OF
ENVIRONMENTAL
CONSERVATION
MONTPELIER

AGENCY MEMORANDUM

SUBJECT

Gale Meadows - Londonderry

TO: Edward F. Kehoe, Commissioner, Department of Fish & Game

FROM: Donald H. Spies, Dam Construction Engineer
Department of Water Resources

DATE: November 17, 1972

The writer inspected the subject structure on November 2, 1972. This impoundment has two dams on: the main dam which creates the pond and a retaining dike which prevents flood waters from passing through a saddle east of the main dam. The main dam is an earth fill structure with a concrete box drop inlet for the primary spillway and an earth cut channel for the emergency spillway. The primary spillway has stop planks to control the water level and the emergency spillway has a concrete control weir across the crest. There are no spillway facilities at the earth fill retaining dike. At the time of the inspection, this writer was unaware of the retaining dike and thus only made an inspection of the main dam.

The dam is in good shape. However, some seepage was noted on the west abutment. This may be due to water traveling along the interface between the fill and the valley wall. There is supposed to be a cutoff trench with a clay core, but it could be defective or not deep enough. At any rate, the situation should be observed for a couple of years to see if it worsens.

The emergency spillway needs to be cleaned out of the brush growth and debris. Also, the exit end has started to erode and should be regraded or backfilled with large blocky boulders (18" to 24").

cc: Robert Collins, Maintenance Supervisor
Richard Soars, Land Negotiator

ROUTING

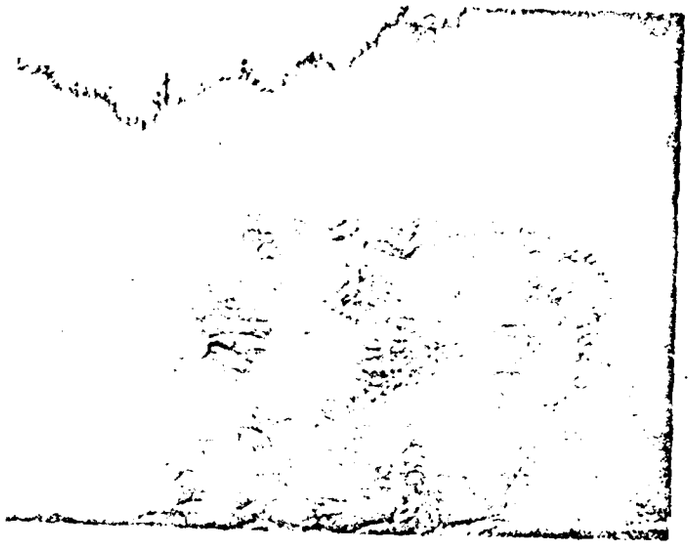
GENERAL

TO	NOTED	DATE
DHS	DHS	11-17-72
JEC	JEC	

SUSPEND TO

FILE

AEC 5M 1-72



MANAGEMENT & ENGINEERING DIVISION

September 29, 1975

N D U M

To: Edward F. Kehoe, Commissioner, Department of Fish & Game

From: Donald H. Spies, Engineer, Department of Water Resources

Subject: Gale Meadows Dam - Winhall

On August 4, 1975, I inspected the subject structure and found it to be in satisfactory condition. There is still seepage at the junction of the downstream fill and the right abutment; the water emerges about 10' vertically from the toe. Some additional seepage was noted along the right wingwall at the outlet of the primary spillway. The seepage does not appear to be critical at this time, but should be monitored regularly to detect changes in the nature of the flow. The fill in the general area appeared to be dry and firm, indicating the seepage to be localized.

The emergency spillway is in unsatisfactory condition. The greatest problem is the severe erosion at the downstream end of the exit channel. The channel needs to be modified to prevent the erosion from working back to the control section. What remains of the original channel is heavily overgrown with trees and brush which normally should be cut and removed. However, it may be well to leave it for the immediate future as a control on the erosion.

The principal spillway was not fully inspected, but seemed to be in satisfactory condition. The iron work on the bridge should be scheduled for re-painting in the next couple of years.

DHS/vdl

Memo

dlps A(1)
AJR 8/27

AJR DM

m: DHS

Gale Meadows Dam - Winhall / Londonderry

On August 19th, I made a visual inspection of the subject structure. The dam appears to be structurally stable and suffered no apparent damage dur the recent storm. The emergency spillway however, suffered erosional damage in th exit channel.

It was difficult to assess the ext of damage because the limits of dama from 1973 were not known. However, there did not appear to be significant erosion towards the control; instead, most of the new damage was in the section previously damaged. I think it may be possible to repair the spillway by backfilling with select materials instead o replacing it.

The control section is still overgrow with brush. Dispite some concentration of flows, the brush did not appear to add significantly to the erosion. However, the brush did aid in the entrapment of deb which reduced the capacity of the spilla I would estimate the reduction was abo thirty percent. All the brush should be cut down and the debris removed.

The dam is in good condition. A few trees have started on the downstream face and these should be cut so extensive roo systems do not become established. There debris on the principle spillway which should be removed. The debris probably

State of Vermont
Agency of Environmental Conservation
Department of Water Resources
Montpelier, VT 05602

DAM INSPECTION REPORT

Name GALE MEADOWS POND DAM DWR No. ~~[illegible]~~ 115-7

Town ~~[illegible]~~ Londonderry NDS No. VT00 # 115

Owner VT. DEPT OF FISH & GAME Inspection Date 5-22-79

Address Montpelier, Vt. 05602 Last Inspected _____

Telephone _____ Hazard Class 3

Size Category _____

PERSONS PRESENT AT INSPECTION (Name and Organization):

Inspecting Party A. P. Borrello, Jr.

Others NONE

I. General Conditions at Time of Inspection

Weather PTLY CLDY 60° Ground Conditions DRY

see back p.6 → Water Surface Elevation +0.1' Datum Gage. weir. P/S

Accessibility accessible

Reservoir Area clear

Remarks

to bulldoze what gravel they could from the stream back into the spillway & then complete the backfill with the quarry run. Frank indicated most of the quarry stone was large size and the small stuff was used for chink in between. He agreed some vegetative cover may be needed.

A (1)

AA-PUR 307 100M 11-76

STATE OF VERMONT

OFFICE MEMO

TO: File

FROM: Dan Spies

DATE: 10-31-77

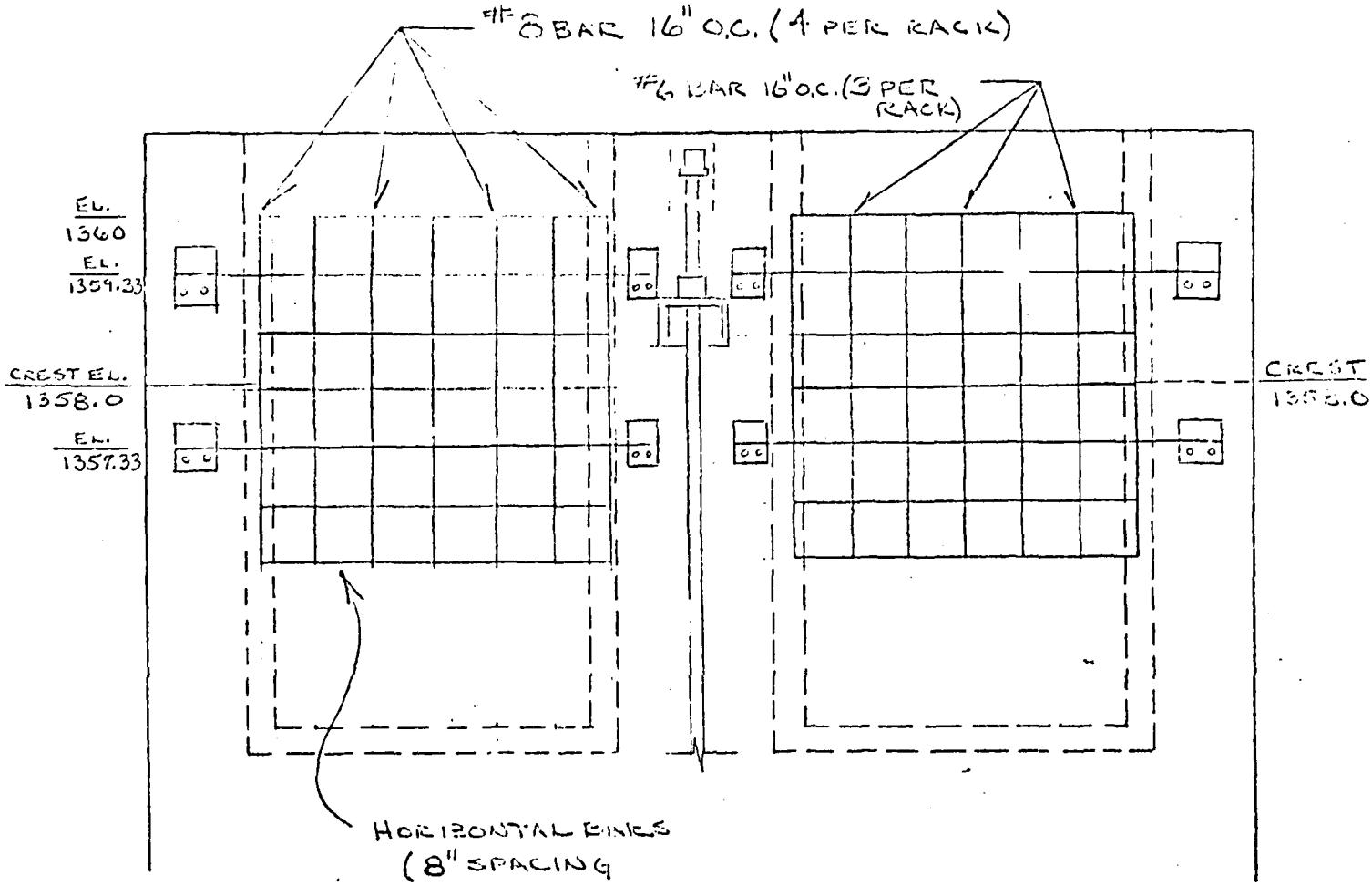
SUBJECT: E.S. @ Gale Meadows Dam - Condendery

- ☐ APPROVAL
- ☐ SIGNATURE
- ☐ COMMENT
- ☐ REVIEW
- ☐ PREPARE REPLY FOR MY SIGNATURE
- ☐ YOUR ACTION REQUESTED BY THIS DATE
- ☐ NOTE AND SEE ME
- ☐ NOTE AND RETURN
- ☐ NOTE AND FILE
- ☐ FOR YOUR INFORMATION
- ☐ PER CONVERSATION
- ☐ AS REQUESTED
- ☐ NECESSARY ACTION
- ☐ GIVE ME THE FACTS
- ☐ SUGGESTIONS REQUESTED

REMARKS: On October 26, 1977, the writer made an inspection of the repairs to the emergency spillway at the Gale Meadows Dam. The fill appeared to be composed of quarry run stone. The surface is composed of fine crushed stone and was not loamed and/or seeded.

On October 28th the writer spoke with Frank Powell of Facilities Engineering. He said he was present during the repairs and the procedure had been

B3-46

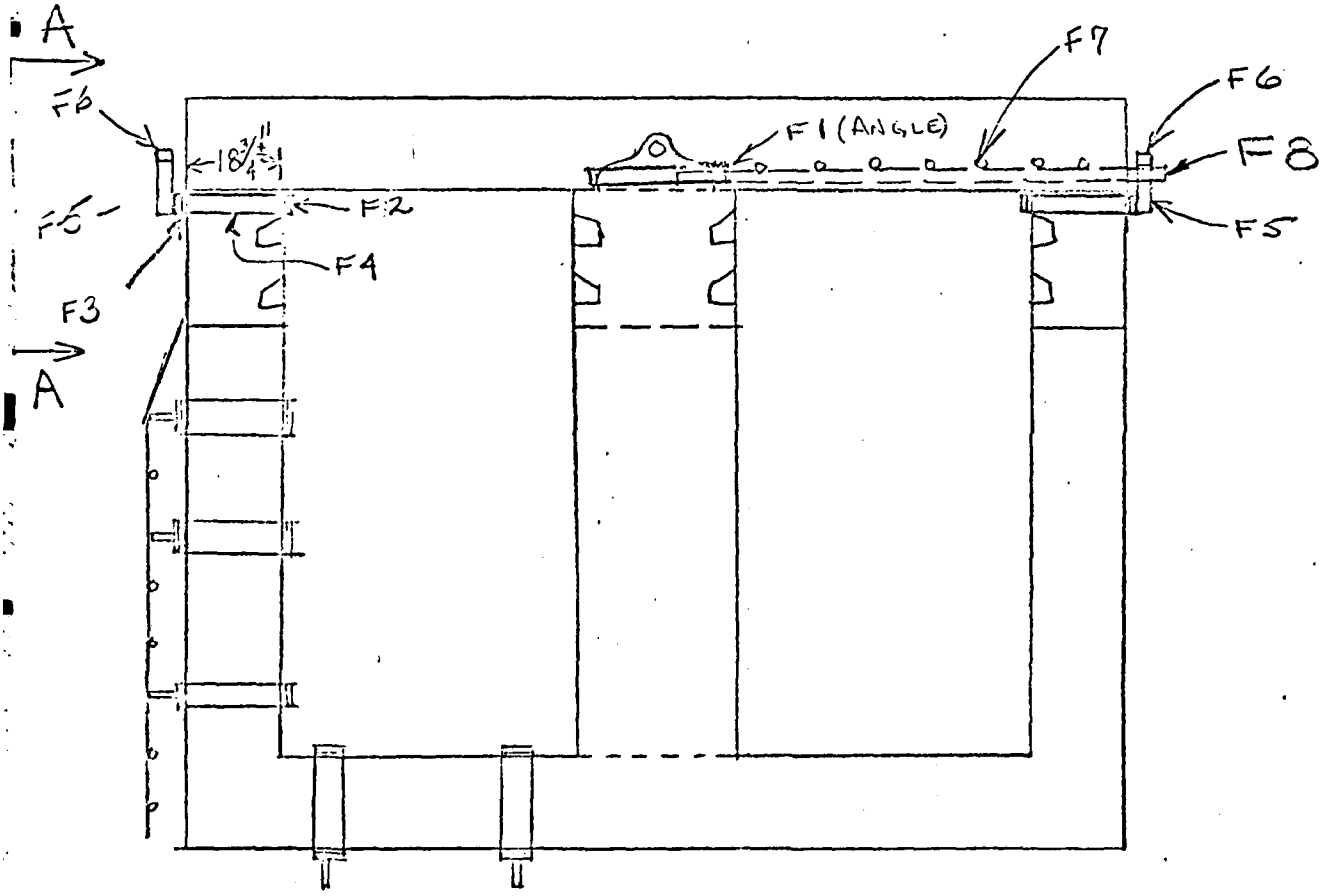

#8 BAR 16" O.C. (4 PER RACK)
#6 BAR 16" O.C. (3 PER RACK)
EL. 1360
EL. 1359.33
CREST EL. 1358.0
EL. 1357.33
CREST
HORIZONTAL BARS (8" SPACING

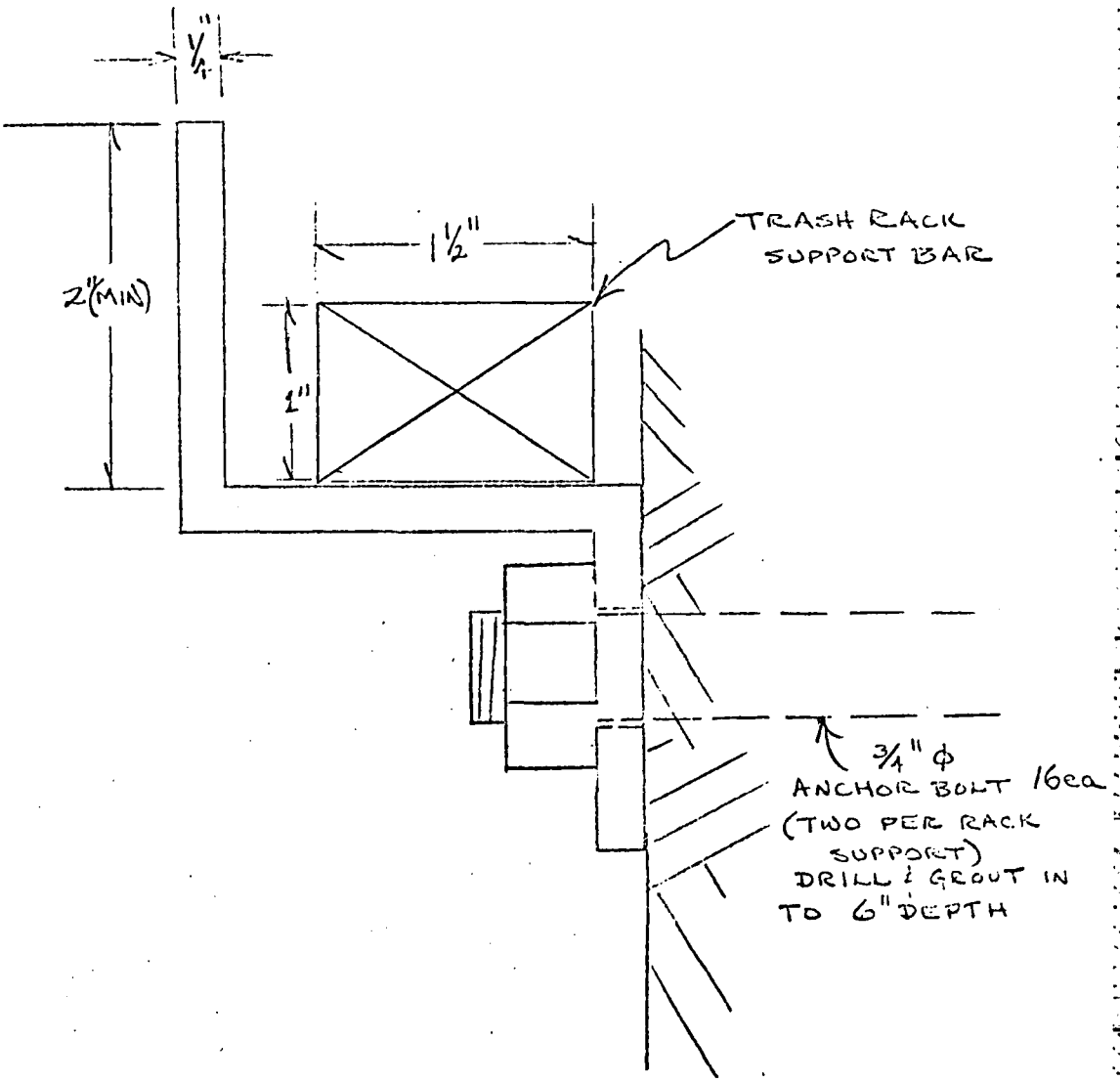
DATE ..... JOB NO. .....

GALE MEADOWS - OUTFLOW STRUCTURE

TRASH RACK FOR FRONT (FLASHBOARD) SIDE OF STRUCTURE

(PLAN VIEW)





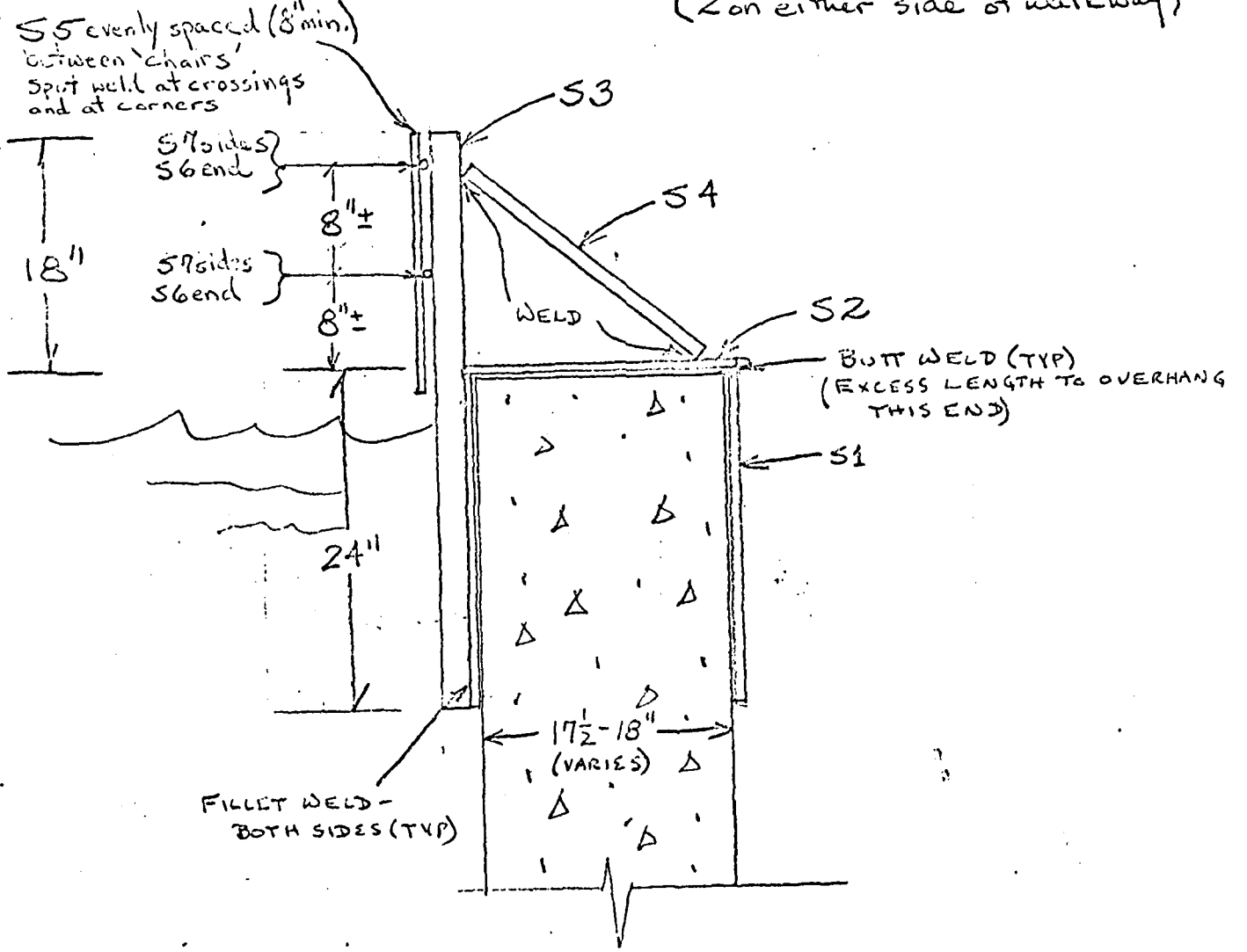
GALE MEADOWS DAM
TRASH RACK SUPPORT
N.W. SIDE OUTLET STRUCTURE

CKD. BY ..... DATE ..... JOB NO. .....

GALE MEADOWS OUTFLOW STRUCTURE

SUPPORT 'CHAIRS' (TYP.)

(10 ea) 3 each on 'sides' of structure
4 each on side opposite flashboards
(2 on either side of walkway)



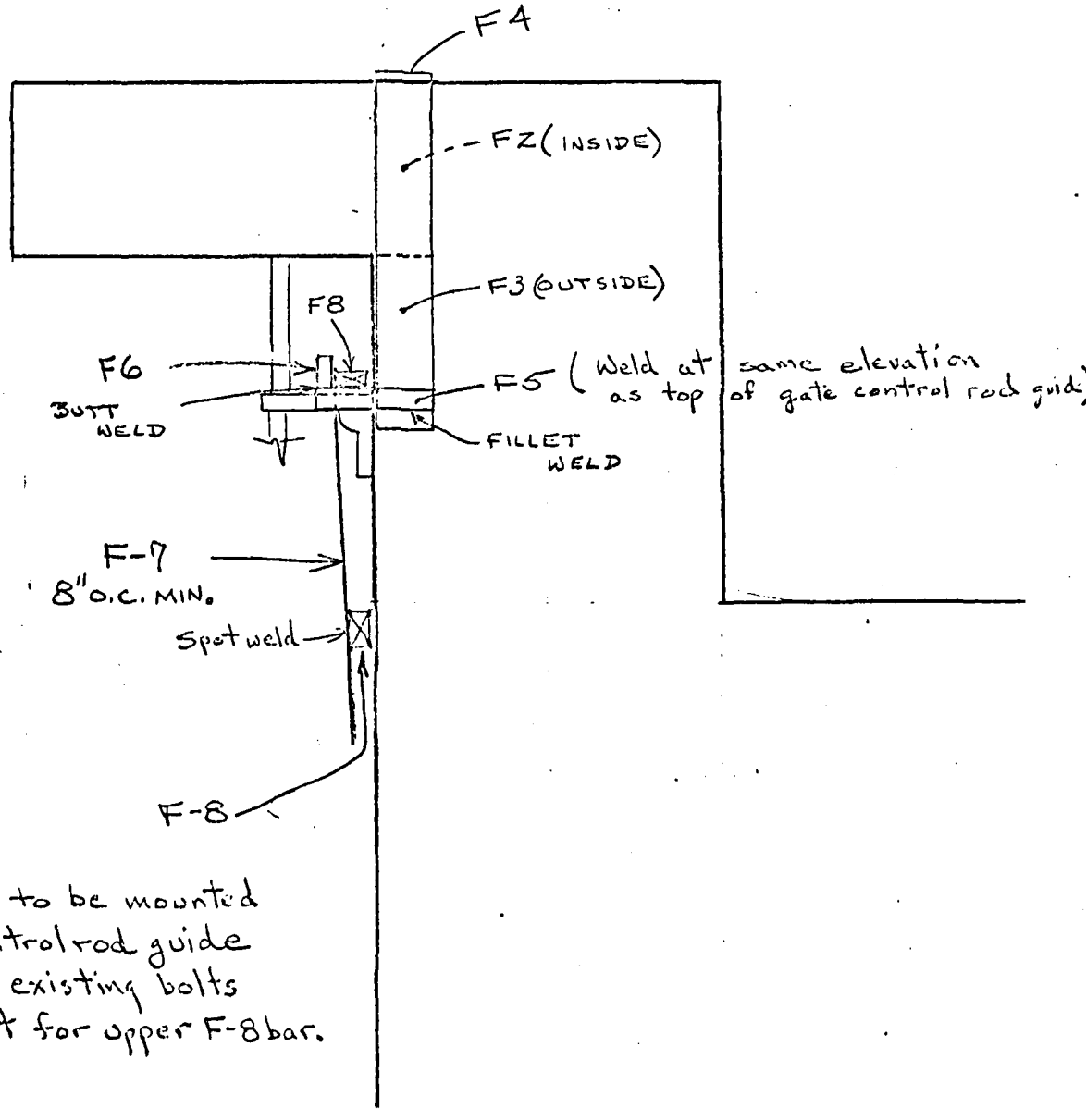
NOT TO SCALE

CHKD. BY ..... DATE ..... JOB NO. .....

GALE MEADOWS DAM

SIDE VIEW - OUTLET CONTROL STRUCTURE SHOWING TRASH RACK

SECT. A-A



NOTE: F1 (angle) to be mounted on gate control rod guide by means of existing bolts as a support for upper F-8 bar.

Ray –

I had arranged w/ Larry to remove the old trash rack & fabricate a new one for the Gale Meadows Dam ([illegible]). I've enclosed materials list and sketches of my thoughts on fabrication – adapt in field as needed. We had originally intended to get this in this fall but our friend in the [illegible] screwed up the materials requisition. If possible this should still go in this fall [illegible] I'm sure you're busy & the weather may not allow [illegible]. If you've got any questions [illegible].

Thank you

Frank [illegible]

Sent to Ray Harwood @ Gifford Woods 10/26/77.

He should be able to complete w/o further assistance if materials are right. [illegible]

B3-40

PS. Work on Emergency Spillway was complete ~10/15.

Bill from Sailor Bros. may come through. If # amount is less than $7195 approve & send to ~~[illegible]~~ Rod Barber (he is flood damage coordinator). If > 7195, there should be two separate bills – one, for 7195 } approve [illegible]
one for excess as eqpt. rental } [illegible]

A(1)

MANAGEMENT & ENGINEERING
July 13, 1977

MEMORANDUM

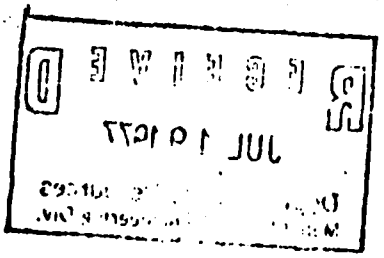
TO: File

FROM: Don Spies

RE: Gale Meadows Dam - Londonderry

On June 22, 1977, the writer made an inspection of the subject structure. Basically, the dam is in the same condition as it was last fall, except there did not appear to be any seepage through the bluff in the emergency spillway.

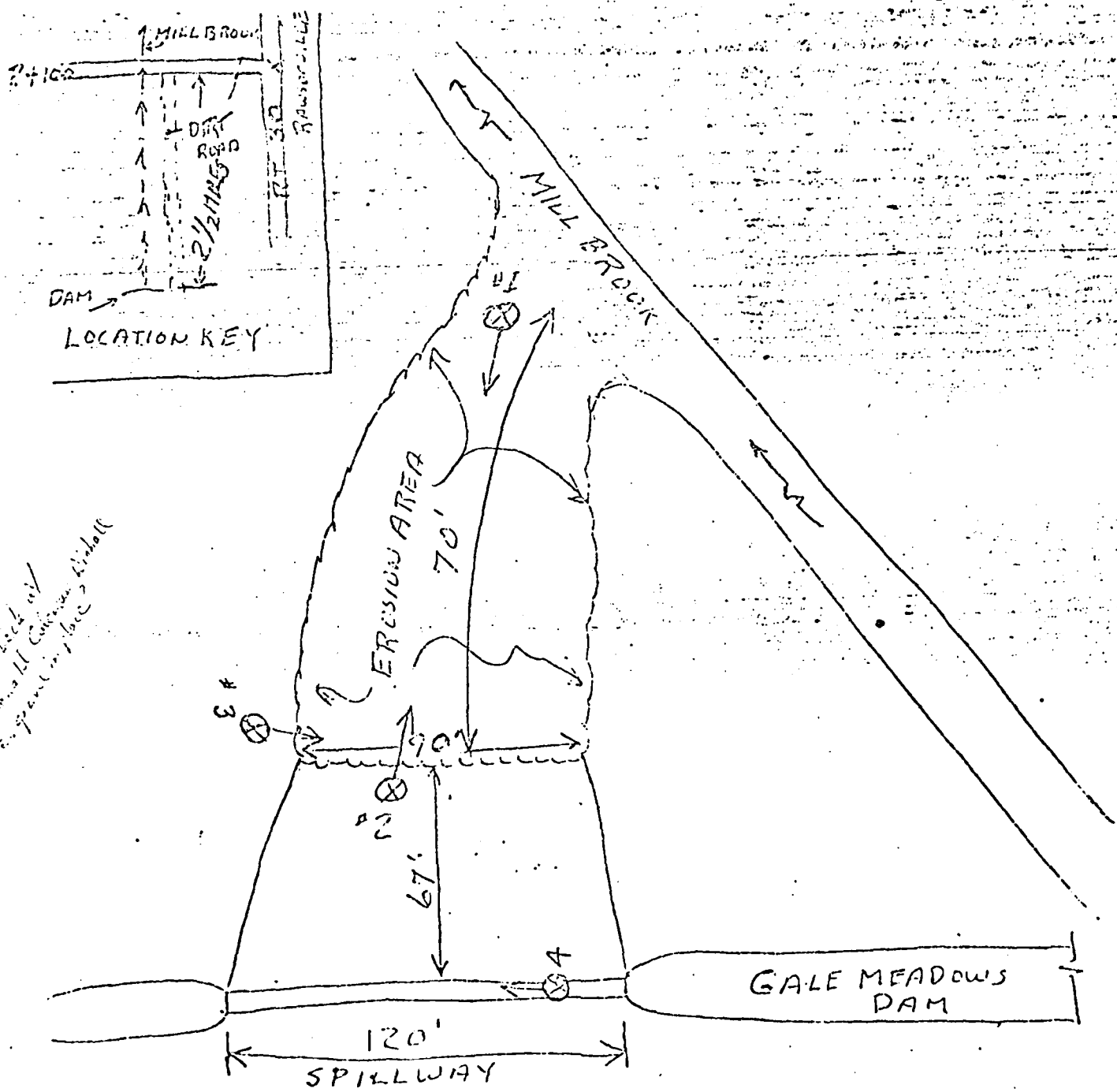
An inspection was made of the drop inlet to the principal spillway. It was found the trash rack has been rendered almost totally useless and much of it in on the inside of the ruser. The rack should be removed before a portion breaks off and becomes lodges in the discharge pipe. The replacement for this rack should be more heavy duty.



SUBJECT _____

COMPUTATION GALE MEADOWS ROAD, SOUTH ROXBURY, VT.

COMPUTED BY _____ CHECKED BY _____ DATE 9/14/76



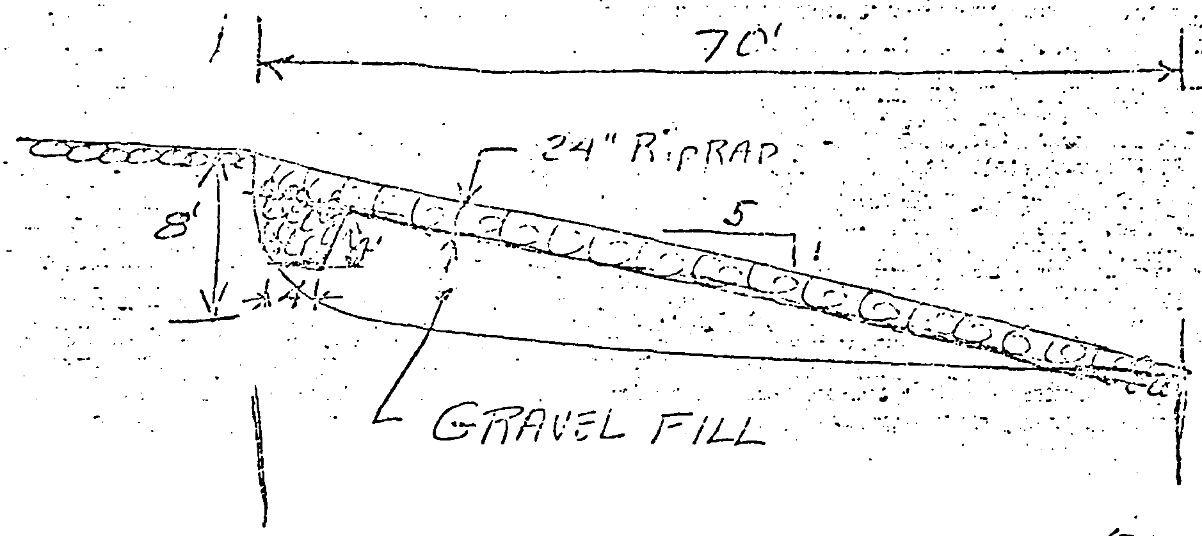
GALE MEADOWS POND

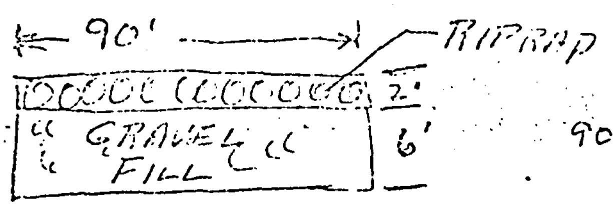
DSR 11-33

SUBJECT [illegible]

COMPUTATION

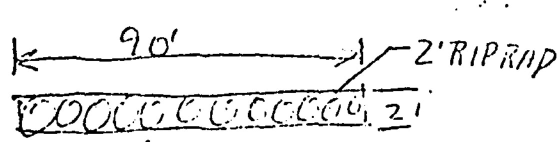
COMPUTED BY ______ CHECKED BY ______ DATE [illegible]





STA 0+00

END AREA RIPRAP	GRAVEL FILL
90x2 = 180 ☐'	90x6 = 540 ☐'
VOL. = $\frac{180^{☐'} \times 70'}{27}$	VOL. = $\frac{540}{2} \times \frac{70}{27}$
VOL = 467 C.Y.	VOL = 700 C.Y.
90x2 = 180 ☐'	90x0 = 0 ☐'



STA 0+70

RIPRAP = 467 C.Y.
GRAVEL FILL = 700 C.Y.

DJR 11-33

GALE MEADOWS POND, DEC 4 1979

Form Approved OMB No 063-R1424

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

DAMAGE SURVEY REPORT

FEDERAL DISASTER ASSISTANCE ADMINISTRATION

(See instructions on reverse of last copy)

3. DECLARATION NO. FDAA 518-DR

4. INSPECTION DATE 9/14/76

1. TO REGION I FEDERAL DISASTER ASSISTANCE ADMINISTRATION (FDAA)

5. WORK ACCOMPLISHED BY
- [X] CONTRACT
- [ ] FORCE ACCOUNT

2. APPLICANT (State Agency, County, City, etc) STATE OF VERMONT AGENCY OF ENVIRONMENTAL CONSERVATION DEPT. OF FISH & GAME

PA NO.

7. WORK CATEGORY ("X" Applicable Box)
[X] EMERGENCY
[ ] PERMANENT [ ] A [ ] B [ ] C [X] D [ ] E [ ] F [ ] G [ ] H [ ] I

ITEM NO. 11-33

6. PERCENTAGE OF WORK COMPLETED TO DATE 0%

8. DAMAGED FACILITIES (Location, identification and description)
GALE MEADOWS POND, SO. LONDONDERRY, VT.
SPILLWAY SECTION

9. DESCRIPTION OF DAMAGE
EROSION OF EMERGENCY SPILLWAY CHANNEL, 67 Feet downstream of Concrete spillway weir. Eroded area 90 Ft wide x 70 ft. long by 8 Ft deep at upstream end. See Sketch

10. SCOPE OF PROPOSED WORK
Fill spillway eroded area with gravel fill, capped with a 2 Ft. layer thickness of riprap in channel area. This work will have no damaging effect to the environment.

11. ESTIMATED COST OF PROPOSED WORK

QUANTITY (a)	UNIT (b)	MATERIAL AND/OR DESCRIPTION (c)	UNIT PRICE (d)	COST (dollars) (e)
700	C.Y.	Gravel Fill - Delivered & Placed	4.65	3255.00
467	C.Y.	Riprap @ Quarry	3.40	1588.00
80	HRS	4-12 YD Dump Trucks	18.00	1440.00
24	HRS	#1-TD-20 DOZER	38.00	912.00
		Rate Quotes		
		Gravel Fill (in-place) from N.Y. Green Book		
		Riprap @ Quarry from Sailor Bros		
		Equipment from MacKenzie		

12. EXISTING INSURANCE (Type) NONE | AMOUNT $ | TOTAL $ 7195.00

13. RECOMMENDATION BY FEDERAL INSPECTOR (Signature, Agency, date)
[signature] CE 9/15/76
Eligible [X] YES [ ] NO

ATTACHMENTS: SKETCHES PHOTOS

14. CONCURRENCE IN REPORT BY STATE INSPECTOR (Signature, Agency, date)
Donald H. [signature] WR SEP 16, 1976
[X] YES [ ] NO

ATTACHMENTS

15. CONCURRENCE IN REPORT BY LOCAL REPRESENTATIVE (Signature, Agency, date)
[signature] 9/17/76
[X] YES [ ] NO

B3-36

FEDERAL REVIEW (Signature, Agency, date)
[signature] C/E 21 Sept 1976

FDAA REVIEW (Initials and date)

COPY 1 FINANCIAL MANAGEMENT

caused a reduction in capacity at this spillway also, but it is difficult to say by how much. Thirty percent is probably a reasonable value.

The seepage at the right abutment is about the same, but the seepage near the spillway outlet has apparently ceased.

Andy: See inspection report dtd August 4, 1975 - within file for comparison

Lmm

P.S. It was noted there is seepage at the toe of the "cliff" left by the erosion. The seepage at present is just enough to keep the bottom wet but is not discharging any water.

II. Condition of Main Structure

Type of Construction EF

A. Upstream Face or Slope

1. Vegetative Cover good grass cover — some brush, mostly along U/s edge stone slope protection — center section mowed
2. Erosion none
3. Slumps, Slides, Cracks n/o
4. Animal Burrows n/o
5. Slope Protection cobble/boulder rock rust — good but brush growing up
6. Debris slope clear — some driftwood, logs along ℄
7. Structural stable, dry
8. Abutments brush @ right
9. Alignment OK
10. Movement n/apparent
11. Remarks good

B. Downstream Face or Slope and Toe

1. Vegetative Cover good grass cover – mowed – some brush l/s near l/s grassed access road

2. Erosion none, significant but path from crest to outlet headwall minor at right abut 1/2 down slope

3. Slumps, Slides, Cracks n/o

4. Animal Burrows n/o

5. Slope Protection none

6. Debris none

7. Seepage none observed except at outlet (see p.5)

8. Piping none observed

9. Boils n/o

10. Toe Drains none

11. Scour none

12. Structural stable, dry

13. Abutments ok except for #2

14. Alignment OK

15. Movement n/apparent

16. Remarks Good - evidence that brush & small trees have been cut within last year or two

C. Crest

1. Vegetative Cover sparse grass

2. Erosion none @ E/S

3. Evidence of Overtopping none

4. Settlement, Cracks none

5. Animal Burrows n/o

6. Debris none

7. Use of crest (road, trail, etc.) ↑

8. Structural (path & maintenance road but cable with lock bars across to vehicles). Stable

9. Abutments OK

10. Alignment OK

11. Remarks generally good

III. Condition of Outlet Works

A. Principal Spillway

Type box d/I

Controlled or Uncontrolled stop log

1. Approach Channel n/a

2. Transition n/a

3. Control Section conc. good - minor erosion

4. Discharge Channel

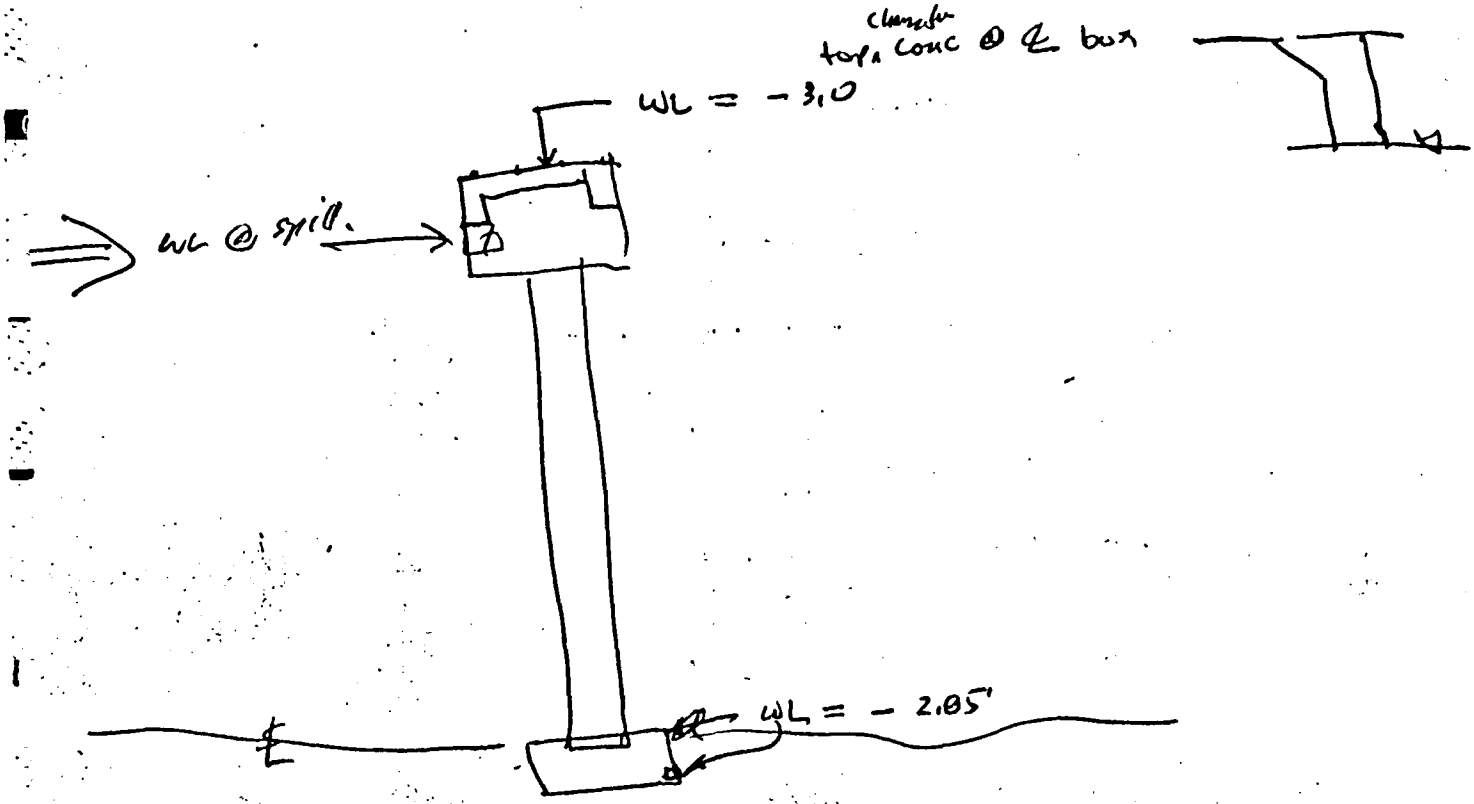
5. Intake Structure

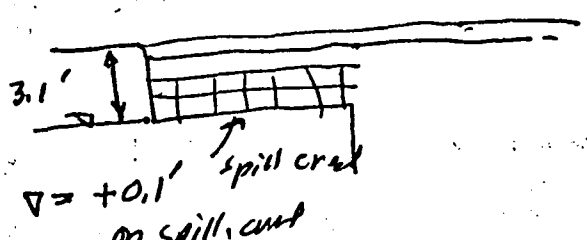
6. Conduit flume to high density walk pipe.

7. Outlet Structure conc headwall - OK minor seepage on stone fill at right side - 2 trees in channel below outlet

8. Trash Racks logs & debris

9. Anti-vortex Devices none





∇ = +0.1' on spill. crest

10. Stop Logs, Flash Boards _____

11. Remarks Good condition - walkway plank dead UK bent rail, fence & timber truss need repairing

B. Emergency Spillway

Type Earth cut with conc. weir

Controlled or Uncontrolled uncontrolled

1. Approach Channel appears to be clear - steep u/s

2. Transition some grass, growing up with brush

3. Control Section Conc. good - some logs, much brush

4. Discharge Channel d/s segment rip rap - growing up with brush & trees - d/s segment crushed stone - clear & brush

5. Remarks brush s/b cut, debris removed otherwise good

C. Drawdown Facilities, Gates, Drains, Appurtenances, Etc.

1. Drawdown Facility Stop log structure - see above

Condition _____

2. Other Gates, Drains, Appurtenances _____

_____

Condition _____

_____

3. Remarks _____

_____

_____

_____

IV. Operation and Maintenance

Maintenance generally good on slopes. Needs brush cut u/s slope + E/S.
Tree removal from d/s channel. Debris removed from spillways.

_____

_____

V. Inspection Summary

A. Information Obtained

1. Photographs ✓

2. Dimensions _____

3. Other _____

B. Additional Information Needed

None

_____

_____

C. Overall Condition of Dam

Good

_____

_____

_____

VI. General Comments

Good condition, needs maintenance.

Report By A. Peter Barrance
A. Peter Barrance, Jr. PE
Dam Safety Engineer

Date 5/28/79

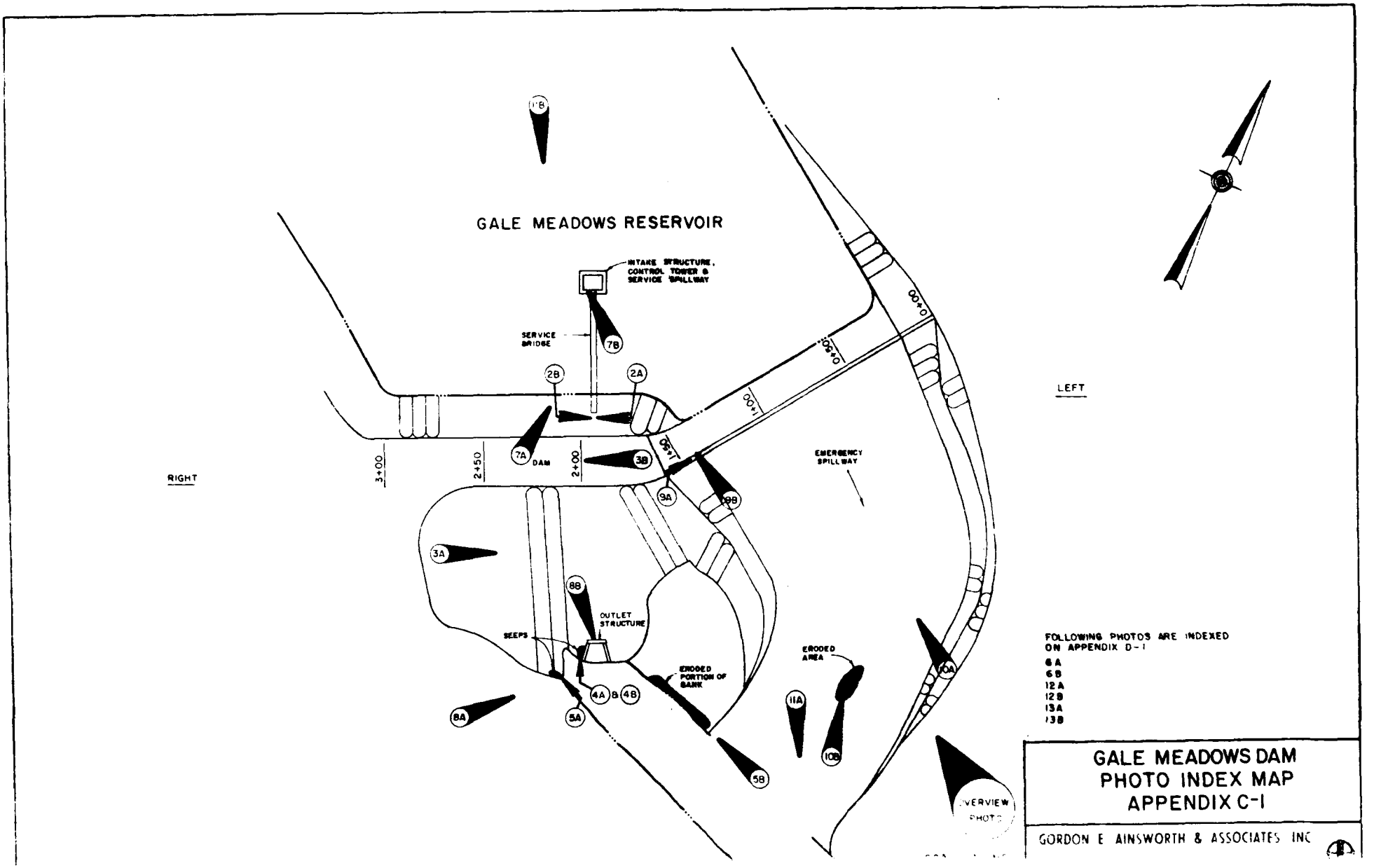
Attachments:

12 mi d/s private? plank bridge with new conc. abut.

Class 3

APPENDIX C

PHOTOGRAPHS



FOLLOWING PHOTOS ARE INDEXED ON APPENDIX D-1

6A
6B
12A
12B
13A
13B

GALE MEADOWS DAM PHOTO INDEX MAP APPENDIX C-1

GORDON E AINSWORTH & ASSOCIATES INC

C-2A Upstream face of dam looking toward right abutment.
11/19/79

C-2B Upstream face of dam looking toward left abutment.
Note emergency spillway weir in right background.
11/19/79

C-3A Downstream face of dam looking from right abutment near the toe toward left abutment - 11/19/79

C-3B Dam crest looking toward right abutment - 11/19/79

C-4A Seep at right wingwall of service spillway outlet structure. 11/19/79

C-4B Close-up of flowing water from seep shown in Photo C-4A above. 11/19/79

C-5A Seep at downstream end of right abutment contact line looking upstream. The bottom of the rule in the photo is at the top of the seep. 11/19/79

C-5B Erosion zone in the natural ground between the service spillway outlet structure and the emergency spillway discharge channel. This view is looking upstream toward the right side of the dam. 11/19/79

G. E. Ainsworth Associates
20 Sugarloaf Street
S. DEERFIELD, MA 01373
Phone 665-2161

JOB GALE MEADOWS DAM
SHEET NO. ____ OF ____
CALCULATED BY ELV DATE 2/7/80
CHECKED BY GPB DATE 10/9/80
SCALE 21-06-79109

DISCHARGE COMPUTATIONS - SERVICE SPILLWAY

SERVICE SPILLWAY CONSISTS OF:

2 - 3.75' LONG SHARP-CRESTED WEIRS

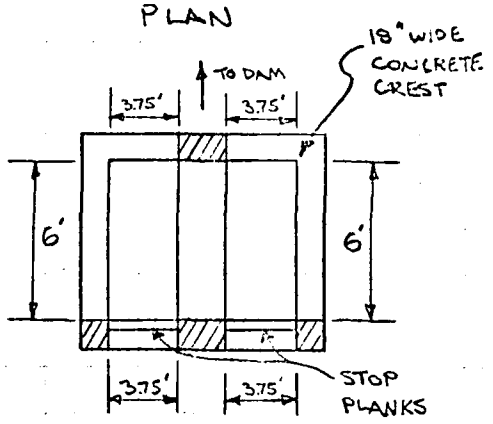
2 - 9.75' LONG SHARP-CRESTED WEIRS

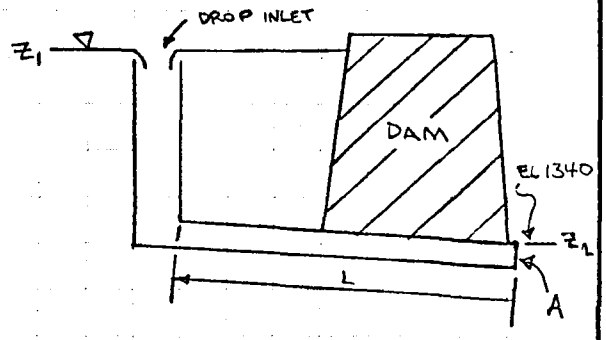
FOR FLOW WHEN WEIR FLOW CONTROLS:

$$Q = 3.33\left(L - 0.2H\right)H^{1.5}$$ (REFERENCE 16)

FOR FLOW WHEN SPILLWAY OUTLET PIPE CONTROLS:
(USE BERNOULLI'S EQUATION)

PLAN





SCHEMATIC SECTION THROUGH DROP INLET SPILLWAY

$L = 180'$ $\quad A = \frac{\pi D^2}{4} = 19.635\ \text{ft}^2$

$n = 0.013$

$D = 5'$ $\quad R = \frac{D}{4} = 1.25'$

$k_{entrance} = 0.5$

$$h_f = \frac{Q^2 n^2 L}{2.21 A^2 R^{4/3}}$$ (MANNING'S EQUATION)

$$h_{entrance} = k_{en}\frac{V^2}{2g}$$

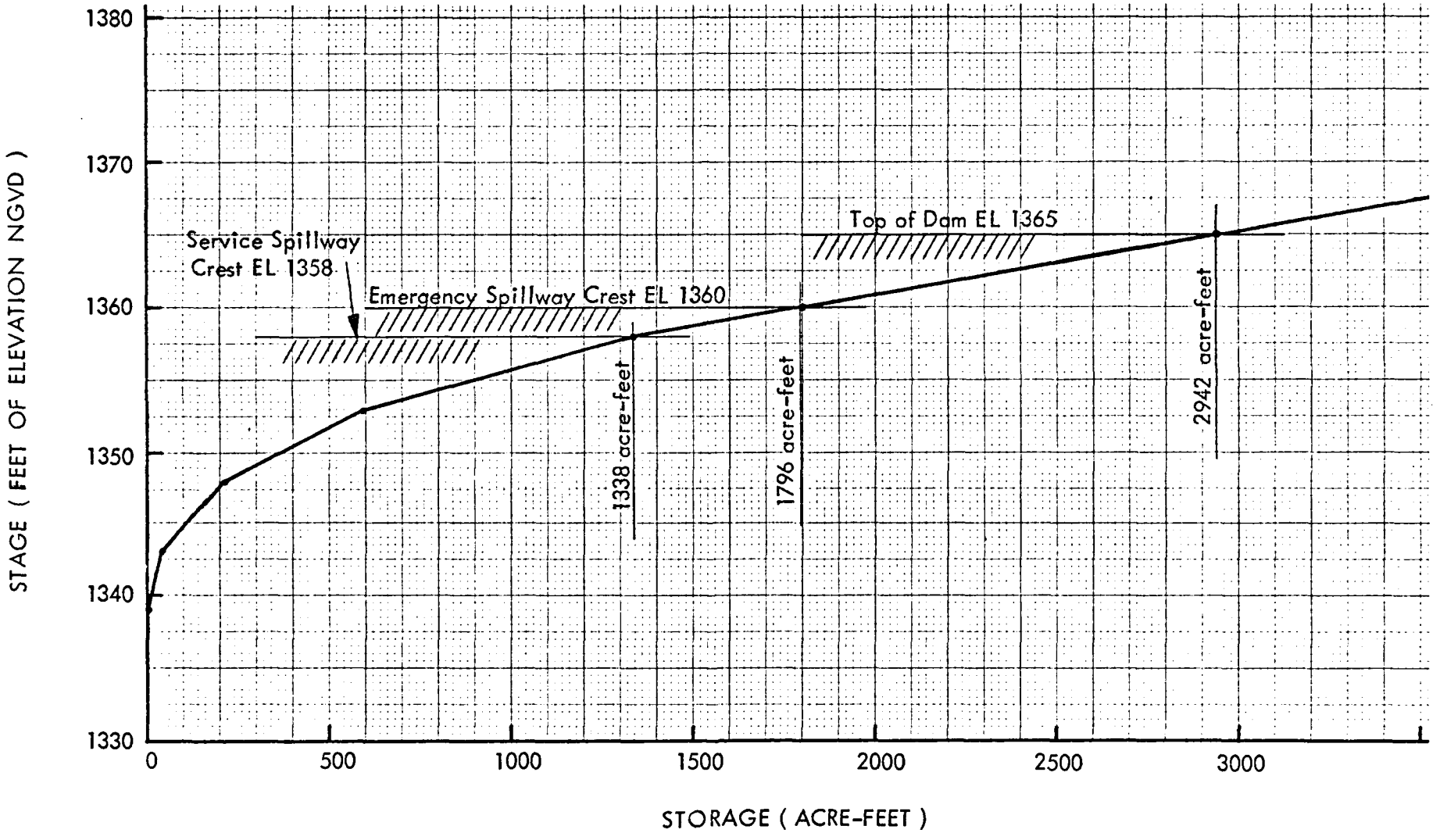
$$\frac{P_1}{\gamma}^{0} + \frac{V_1^2}{2g}^{0} + Z_1 = \frac{P_2}{\gamma}^{0} + \frac{V_2^2}{2g} + h_{en} + h_f$$

$$Q = \left(\frac{Z_1 - Z_2}{\frac{k_{en}+1}{2gA^2} + \frac{n^2 L}{2.21 A^2 R^{4/3}}}\right)^{1/2}$$

$$Q = \left(\frac{Z_1 - 1340}{8.693 \times 10^{-5}}\right)^{1/2}$$

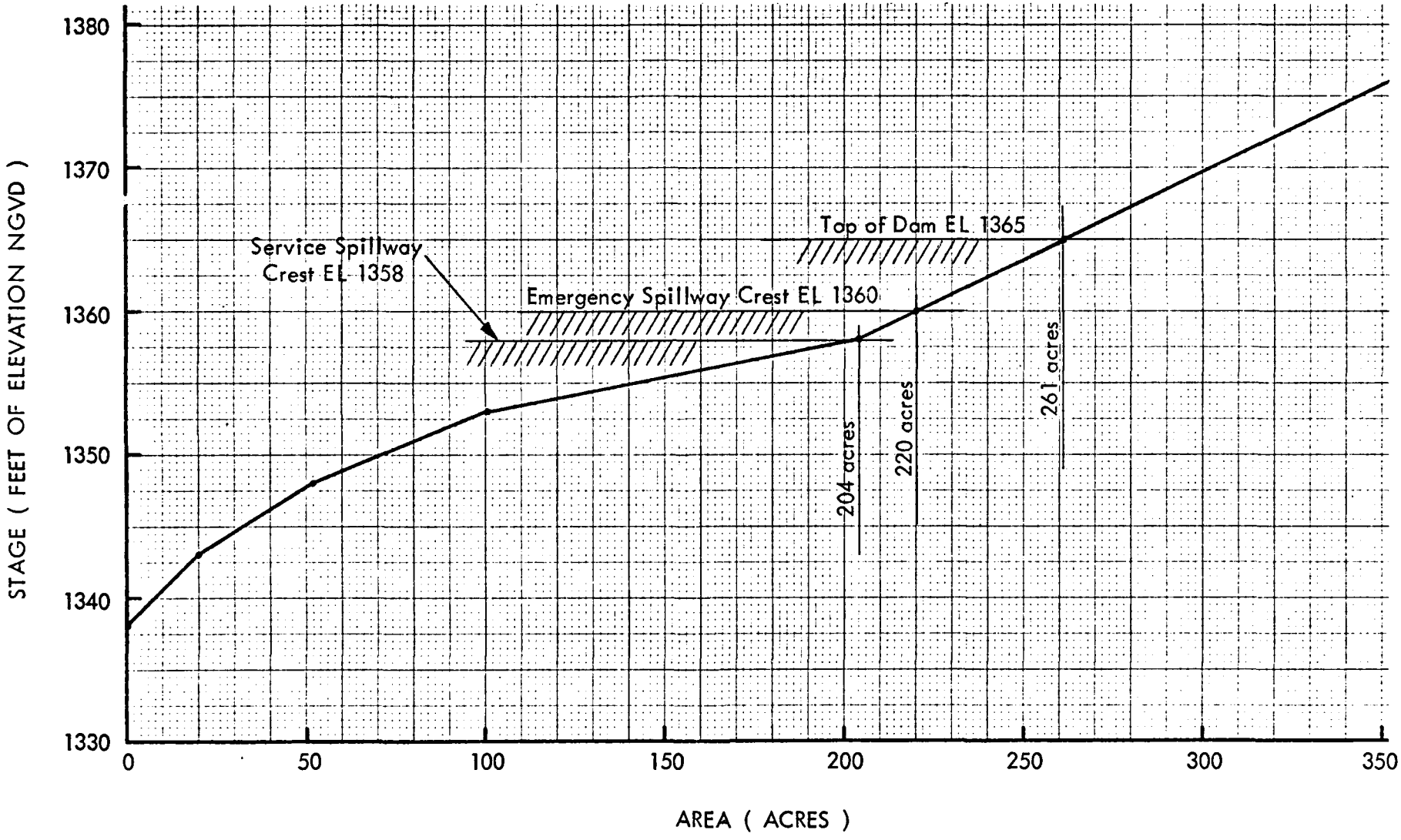
GALE MEADOWS DAM, LONDONDERRY, VERMONT

STAGE - STORAGE



GALE MEADOWS DAM, LONDONDERRY, VERMONT

STAGE - AREA



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JOB GALE MEADOWS DAM
SHEET NO. ____ OF ____
CALCULATED BY ELV DATE 2/7/80
CHECKED BY GPB DATE 10/9/80
SCALE 21-06-79109

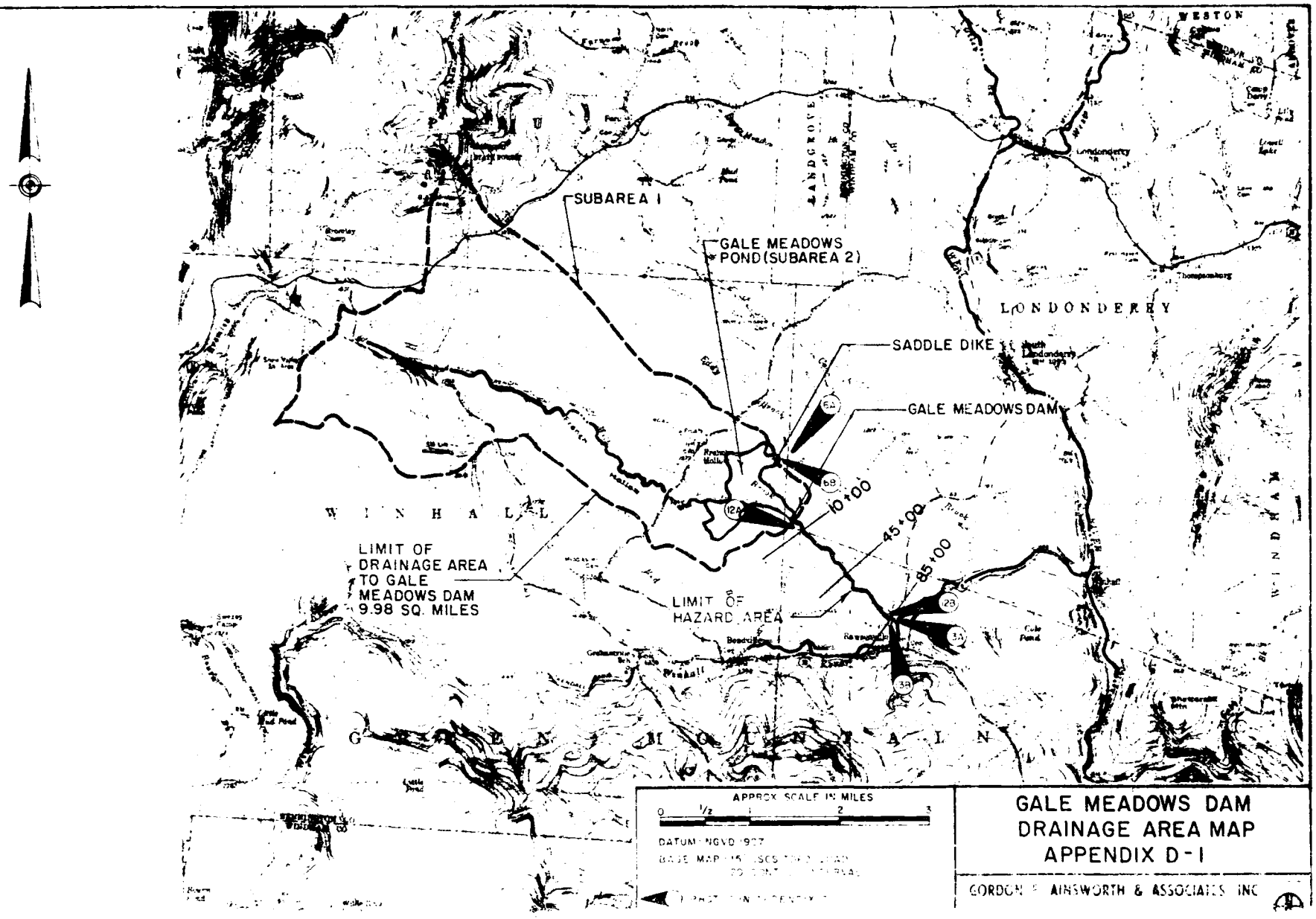
ELEVATION - AREA - STORAGE COMPUTATIONS

RESERVOIR VOLUME: COMPUTED BY PROGRAM USING METHOD OF CONIC SECTIONS: $\Delta V_{12} = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2})$

	ELEVATION (NGVD - ft)	AREA (acres)		V_t (acre-feet)	
	1338	1.2	BATHYMETRIC MAP	0	
	1343	19.6		43	
	1348	51.8		215	
	1353	101.1		590	
SERVICE SPILLWAY CREST →	1358	204.0		1338	FLOWAGE AREA = 210 ACRES PER APPENDIX B2-6
EMERGENCY SPILLWAY CREST →	1360	220 (EST.)		1796 (EST.)	
TOP OF DAM →	1365	261 (EST.)		2942	
	1380	384.4	USGS	7707	

DRAINAGE AREA

	AREA (acres)	AREA (square miles)
RESERVOIR SURFACE (SUBAREA 2) @ NORMAL POOL EL = 1358	204.0 BATHYMETRIC MAP	0.319
WATERSHED DIRECT TO RESERVOIR (SUBAREA 1)	6181.1 USGS MAP	9.658
DRAINAGE AREA TO GALE MEADOWS DAM	6385.1	9.977


SUBAREA 1
GALE MEADOWS POND (SUBAREA 2)
SADDLE DIKE
GALE MEADOWS DAM
LIMIT OF DRAINAGE AREA TO GALE MEADOWS DAM 9.98 SQ. MILES
LIMIT OF HAZARD AREA
10+00
45+00
85+00
WESTON
LONDONDERRY
WINHALL
WINDHAM
APPROX SCALE IN MILES
0
1/2
1
2
3
DATUM: NGVD 1927
GALE MEADOWS DAM
DRAINAGE AREA MAP
APPENDIX D-1
GORDON E. AINSWORTH & ASSOCIATES INC

25

APPENDIX D

HYDRAULIC AND HYDROLOGIC COMPUTATIONS

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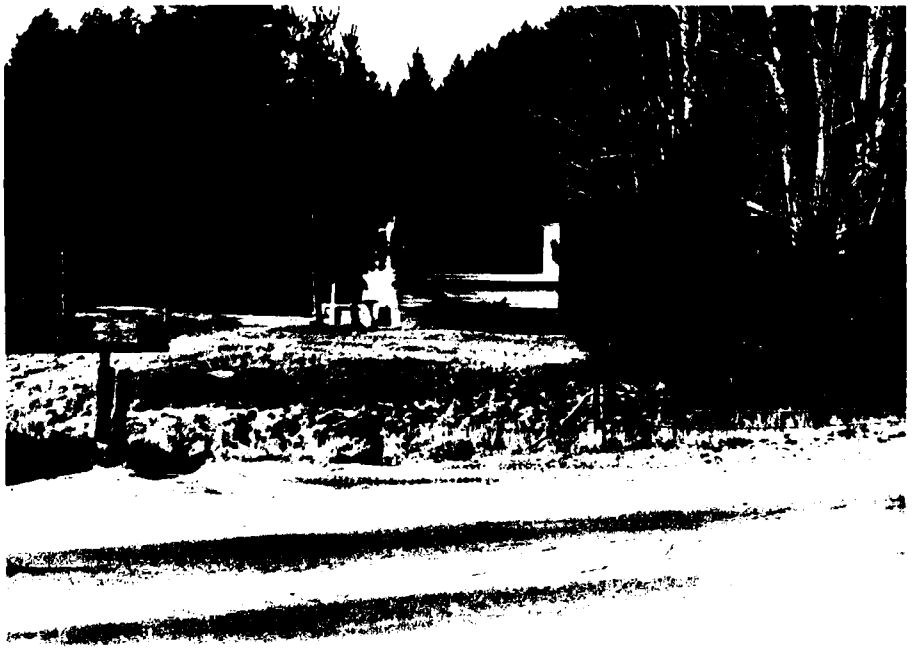
C-13A House and barn in downstream hazard area near Vermont State Route No. 8, looking upstream - 11/19/79



C-13B House trailer in downstream hazard area along Vermont State Route No. 8, looking upstream - 11/19/79

C-12A Bridge over Mill Brook about 1000 feet downstream from dam, looking downstream - 11/19/79

C-12B View of Mill Brook just upstream of Vermont State Route No. 8, looking upstream - 11/19/79

C-11A Bar of quarry-run stone formed at downstream end of emergency spillway discharge channel - 11/19/79

C-11B Aerial overview of Gale Meadows Dam looking downstream. 11/19/79

C-10A Emergency spillway discharge channel looking upstream toward dam crest - 11/19/79

C-10B View of gully eroded into emergency spillway discharge channel looking upstream - 11/19/79

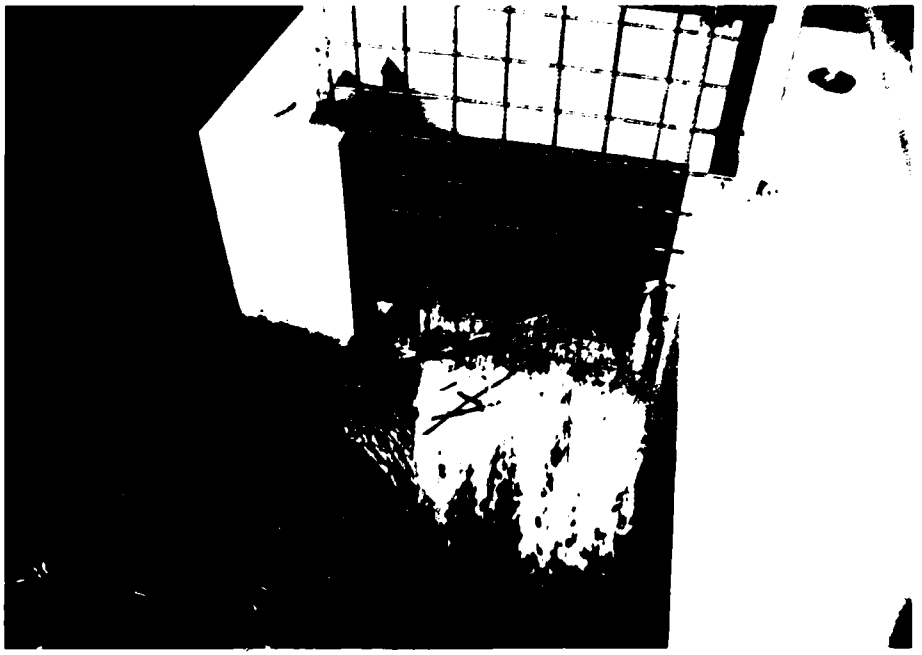
C-9A Emergency spillway weir control section looking toward left abutment - 11/19/79

C-9B Crack through concrete of emergency spillway weir at change of slope at right end - 11/19/79

C-8A Service spillway outlet structure - 11/19/79

C-8B Mill Brook downstream from service spillway outlet structure. Note service spillway structure wingwall at lower left and emergency spillway discharge channel at upper left - 11/19/79

C-7A Drop inlet service spillway structure and service bridge looking from dam crest - 11/19/79



C-7B Close-up of drop inlet service spillway with trash racks in place. Note drain port slide gate operating nut in upper right corner - 11/19/79

C-6A Aerial overview of saddle dike on northeastern part of Gale Meadows Pond, looking westerly toward pond - 11/30/79

C-6B Downstream face of saddle dike looking from right abutment. Note ponded water downstream of dike - 11/19/79

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JOB GALE MEADOWS DAM
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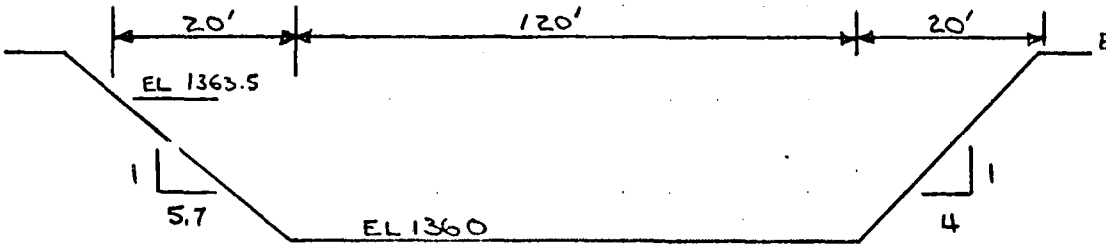
DISCHARGE COMPUTATIONS

SERVICE SPILLWAY CAPACITY (DROP INLET)

ELEVATION (NGVD-ft) z_1	WATER DEPTH (feet)	3.75' LONG WEIR Q (cfs)	9.75' LONG WEIR Q (cfs)	TOTAL LENGTH WEIR Q (cfs)	OUTLET PIPE Q (cfs)	$Q_{DROP\ INLET\ SPILLWAY}$ (cfs)
1358	0	0	0	0	—	0
1359	1	11.8	31.8	87.2	—	87
1360	2	31.6	88.1	239.4	—	239
1361	3	54.5	158.3	425.6	491.5	426
1362	4	78.6	238.4	634.0	503.1	503
1363	5				514.4	514
1364	6				525.4	525
1365	7	TOP OF DAM			536.3	536 SAY 540
1366	8				546.9	547
1367	9				557.3	557
1368	10				567.5	568
1369	11				577.6	578
1370	12				587.5	588

EMERGENCY SPILLWAY CAPACITY (OVERFLOW)



WEIR CREST LOOKING UPSTREAM

WEIR IS 18" WIDE BUT APPROACH + DISCHARGE CHANNELS ARE ABOUT LEVEL W/ WEIR

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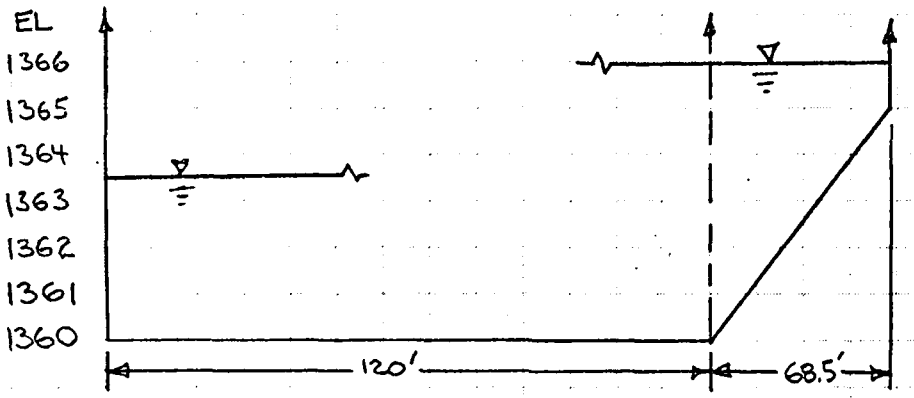
DISCHARGE COMPUTATIONS

EMERGENCY SPILLWAY



TRANSPOSED WEIR SECTION FOR EMERGENCY SPILLWAY

FORMULAS FOR FLOW THROUGH TRAPEZOIDAL WEIR SECTIONS (REFERENCE 3)

$d_c = \frac{2}{3}(H_m + \frac{1}{4}\Delta y)$

$A = \frac{1}{2} T (2d_c - \Delta y)$

$Q_c = \left(\frac{A^3 g}{T}\right)^{1/2}$ ALL SECTIONS

d_c = CRITICAL DEPTH

Δy = CHANGE IN ELEVATION ACROSS SECTION

H_m = HEIGHT OF WATER SURFACE ABOVE SECTION INVERT

FOR FOLLOWING TYPES OF CRITCAL DEPTH SECTIONS, FORMULAS REDUCE TO:

T = TOPWIDTH AT d_c
L = TOPWIDTH AT H_m

RECTANGLE	TRIANGLE	TRAPEZOID
$\Delta y = 0$	$\Delta y = d_c$	$\Delta y < d_c$
$d_c = \frac{2}{3} H_m$	$d_c = \frac{4}{5} H_m$	d_c (SAME AS ABOVE)
$T = L$	$T = L \frac{d_c}{H_m}$	$T = L$
$A = T d_c$	$A = \frac{T d_c}{2}$	A (SAME AS ABOVE)

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DISCHARGE COMPUTATIONS

EMERGENCY SPILLWAY

	ELEVATION (NGVD)	H_m (ft)	L (ft)	Δy (ft)	d_c (ft)	T (ft)	A (sq ft)	$Q_{PARTIAL}$ (cfs)	Q_{TOTAL} (cfs)
	1360	0	120	0	0	0	0	0	0
	1361	1	120	0	.67	120	80.4	373.4	
		1	9.7	d_c	.8	7.76	3.10	11.1	385
	1362	2	120	0	1.33	120	159.6	1044.4	
		2	19.4	d_c	1.6	15.52	12.42	63.0	1107
	1363	3	120	0	2	120	240	1926.0	
		3	29.1	d_c	2.4	23.28	27.9	173.3	2099
	1364	4	120	0	2.67	120	320.4	2970.8	
		4	38.8	d_c	3.2	31.04	49.7	356.9	3328
TOP OF DAM →	1365	5	120	0	3.33	120	399.6	4137.9	
		5	48.5	d_c	4	38.8	77.6	622.7	4761
									SAY 4760
	1366	6	120	0	4	120	480	5447.5	
		6	48.5	5	4.83	NG	$\Delta Y > d_c$	Use Triangle	
				d_c	4.8	38.8	93.1	818.3	6266
	1367	7	120	0	4.67	120	560.4	6872.0	
		7	48.5	5	5.5	48.5	145.5	1430.1	8302
	1368	8	120	0	5.33	120	639.6	8379.2	
		8	48.5	5	6.17	48.5	178.0	1935.0	10314

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CHECKED BY JPB DATE 10/9/80
SCALE 21-06-79109

DISCHARGE COMPUTATIONS - SUMMARY

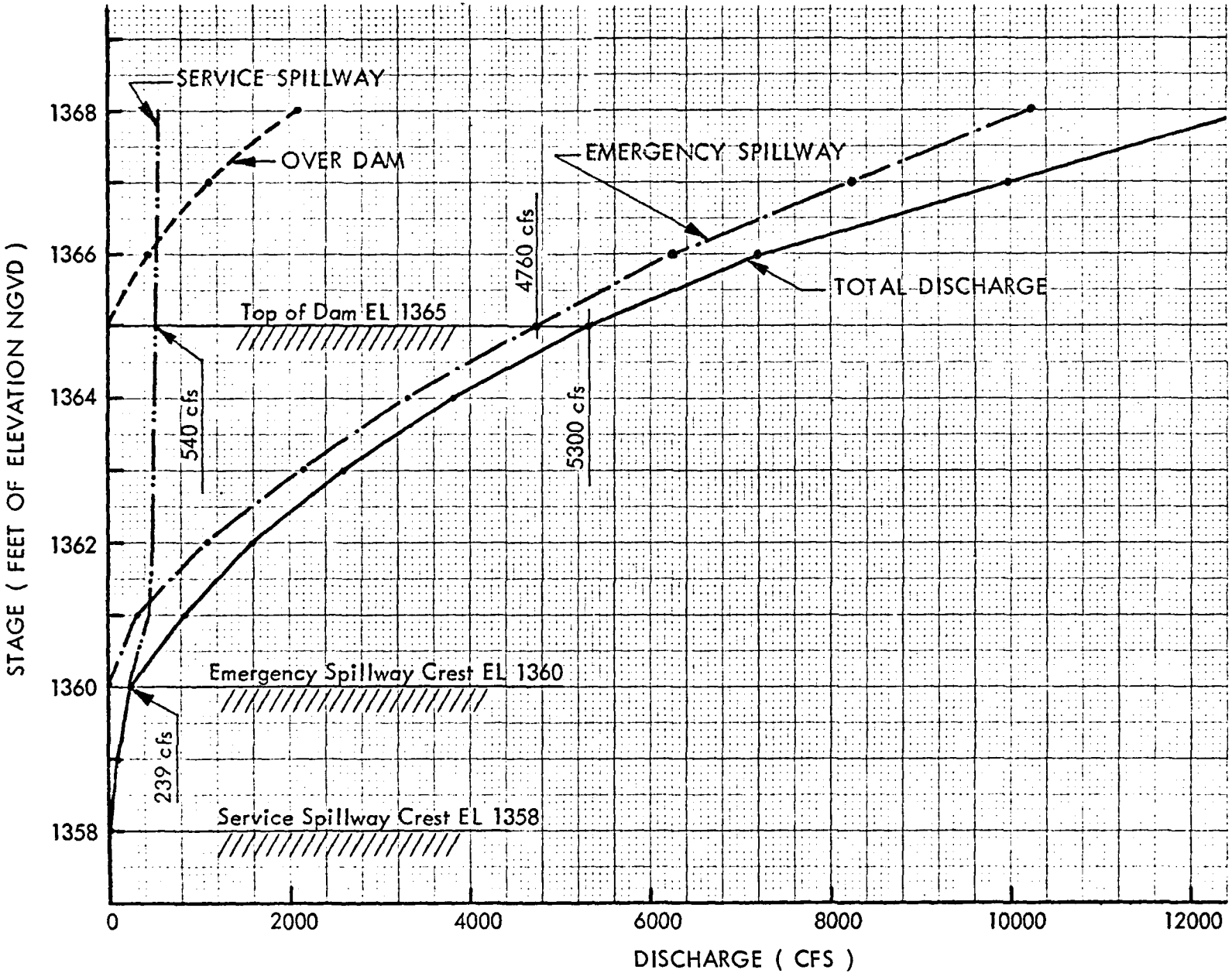
DAM APPURTENANCE	ELEVATION	SIZE
SERVICE SPILLWAY (DROP INLET)	CREST EL = 1358	27' TOTAL WEIR LENGTH
EMERGENCY SPILLWAY (OVERFLOW)	CREST EL = 1360	120' BOTTOM WIDTH OF TRAPEZOIDAL SECTION
DAM	CREST EL = 1365	131.5' CREST LENGTH
DRAIN PORT	CREST EL = 1338	2' x 2' SQUARE

FOR FLOW OVER DAM: $Q_{DAM} = 3.087 L H^{1.5}$ (FORMULA FOR FLOW OVER A BROAD-CRESTED WEIR, REF. 9)

	ELEVATION (NGVD)	$H_{SERVICE}$ (ft)	$H_{EMERGENCY}$ (ft)	H_{DAM} (ft)	$Q_{SERVICE}$ (cfs)	$Q_{EMERGENCY}$ (cfs)	INPUT $Q_{TOTAL\ SPILLWAYS}$ (cfs)	Q_{DAM} (cfs)	$Q_{DRAIN\ PORT}$ (cfs)	Q_{TOTAL} (cfs)
SERVICE SPILLWAY CREST →	1358	0	0	0	0	0	0	0	0	0
	1359	1	0	0	87	0	87	0	DRAIN PORT CLOSED ASSUMED	87
EMERGENCY SPILLWAY CREST →	1360	2	0	0	239	0	239	0		239
	1361	3	1	0	426	385	811	0		811
	1362	4	2	0	503	1107	1610	0		1610
	1363	5	3	0	514	2099	2613	0		2613
	1364	6	4	0	525	3328	3853	0		3853
TOP OF DAM →	1365	7	5	0	540	4760	5300	0		5300
	1366	8	6	1	547	6266	6813	406		7219
	1367	9	7	2	557	8302	8859	1148		10007
	1368	10	8	3	568	10314	10882	2109	0	12991

GALE MEADOWS DAM, LONDONDERRY, VERMONT

STAGE - DISCHARGE



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CHECKED BY GPG DATE 10/9/80
SCALE 21-06-79109

DRAINAGE AREA DATA FOR HEC-1 DB PROGRAM

SUBAREA 1: AREA TRIBUTARY DIRECTLY TO RESERVOIR
AREA = 9.658 SQUARE MILES

LOSS RATES: 1.0" - INITIALLY
0.1"/HOUR - CONSTANT LOSS RATE

UNIT HYDROGRAPH PARAMETERS: USE SNYDER METHOD

A = DRAINAGE AREA = 9.658 SQUARE MILES
L = LENGTH OF MAIN WATERCOURSE TO UPSTREAM LIMIT OF DRAINAGE AREA = 6.02 MILES
L_{CA} = LENGTH OF MAIN WATERCOURSE TO POINT OPPOSITE THE CENTROID OF THE DRAINAGE AREA = 3.55 MILES
C_t = SNYDER'S BASIN COEFFICIENT = 2.0 ASSUMED AVERAGE
C_p = SNYDER'S PEAKING COEFFICIENT = 0.625 ASSUMED AVERAGE
t_p = STANDARD LAG IN HOURS = $C_t(LL_{CA})^{0.3}$ = 5.0 HOURS

∴ USE $t_p = 5.0$ HOURS

SUBAREA 2: RESERVOIR SURFACE
AREA = 0.319 SQUARE MILES (204 ACRES)

LOSS RATES: NONE BECAUSE RAINFALL = RUNOFF FOR WATER SURFACE

UNIT HYDROGRAPH PARAMETERS:

FOR U.H. W/ 5 MINUTE DURATION & 1" RAIN

$$\bar{Q} = \frac{A(1")}{t} = \frac{204 \text{ acres } (1")}{5 \text{ minutes}} \left(\frac{43560 \text{ SQ FT.}}{1 \text{ acre}}\right)\left(\frac{1'}{12"}\right)\left(\frac{1 \text{ minute}}{60 \text{ seconds}}\right)$$

$\bar{Q} = 2468$ cfs (SINCE ZERO LOSS RATE)

```
A NED DAM INSPECTION CONTRACT: DACW-80-C-0012 GMOT1
A VT. 00115 GALE MEADOWS DAM, 21-06-79109
A OVERTOPPING - TEST FLOOD = ONE-HALF PMF
B    288       0       5                                      4
B1     5
J      1       1       1
J1   0.5
K      0    SA-1                                    1
K1 SUBAREA 1 RUNOFF COMPUTATION
M      1       1   9.458              10                      1
P           19.0     111     123     132
T                                                1.0     .10
W    5.0    .625
X    -4.       0       1
K      0  SA-RES                                    1
K1 SUBAREA RESERVOIR RUNOFF
M      1      -1   0.319              10                      1
P           19.0     111     123     132
T                                                  0       0
U      1
U1  2468
X    -4.       0       1
K      2   SA-2C                                    1
K1  COMBINING HYDROGRAPHS 1,2
K      1     RES                       2            1
K1 ROUT FLOWS THROUGH RESERVOIR
Y                              1       1
Y1     1                                       -1358      -1
Y4  1358    1359    1360    1361    1362    1363    1364    1365    1366    1367
Y4  1368
Y5     0      87     239     811    1610    2613    3853    5300    6813    8859
Y5 12882
SA   1.2    19.6    51.8   101.1   204.0   384.4
SE  1332    1343    1348    1353    1358    1380
S*  1358
SD  1365   3.087     1.5   131.5
K     99
A
A
A
A
A
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE:17/09/80
TIME: 1:51 PM

NED DAM INSPECTION CONTRACT: DACW-80-C-0012 GMOT1
VT. 00115 CALF MEADOWS DAM. 21-06-79109
OVERTOPPING - TEST FLOOD = ONE-HALF PMF

JOP SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	4	0

JCPER	NMT	LRCPI	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 0.50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

SUBAREA 1 RUNOFF COMPUTATION

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
SA-1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	9.66	0.00	10.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	19.00	111.00	123.00	132.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LRCPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 5.00 CP=0.63 NTA= 0

RECESSION DATA
STRTQ= -4.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES. LAG= 4.98 HOURS. CP= 0.62 VOL= 0.69

2.	7.	14.	24.	34.	45.	58.	71.	85.	100.
116.	132.	148.	165.	183.	200.	219.	237.	256.	275.
295.	314.	334.	355.	375.	395.	416.	437.	458.	479.
501.	522.	543.	564.	584.	603.	622.	639.	656.	671.
686.	700.	714.	726.	738.	749.	759.	768.	776.	784.
791.	796.	801.	806.	809.	811.	812.	813.	812.	810.
807.	803.	797.	789.	778.	764.	751.	737.	724.	711.
699.	687.	674.	662.	651.	639.	628.	617.	606.	595.
585.	574.	564.	554.	544.	535.	525.	516.	507.	498.

C

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	20.06	17.41	2.65	872234.
										(510.)(442.)(67.)(24698.89)			

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

SUBAREA RESERVOIR RUNOFF

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	SA-RES	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	0.32	0.00	10.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	19.00	111.00	123.00	132.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00

RECESSION DATA

STRTQ= -4.00 QRCSN= 0.00 RTIOR= 1.00

C

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	20.06	20.06	0.00	49871.
										(510.)(510.)(0.)(1412.19)			

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINING HYDROGRAPHS 1,2

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	SA-2C	2	0	0	0	0	1	0	0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUT FLOWS THROUGH RESERVOIR

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	RES	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1358.	-1

STAGE	1358.00	1359.00	1360.00	1361.00	1362.00	1363.00	1364.00	1365.00	1366.00

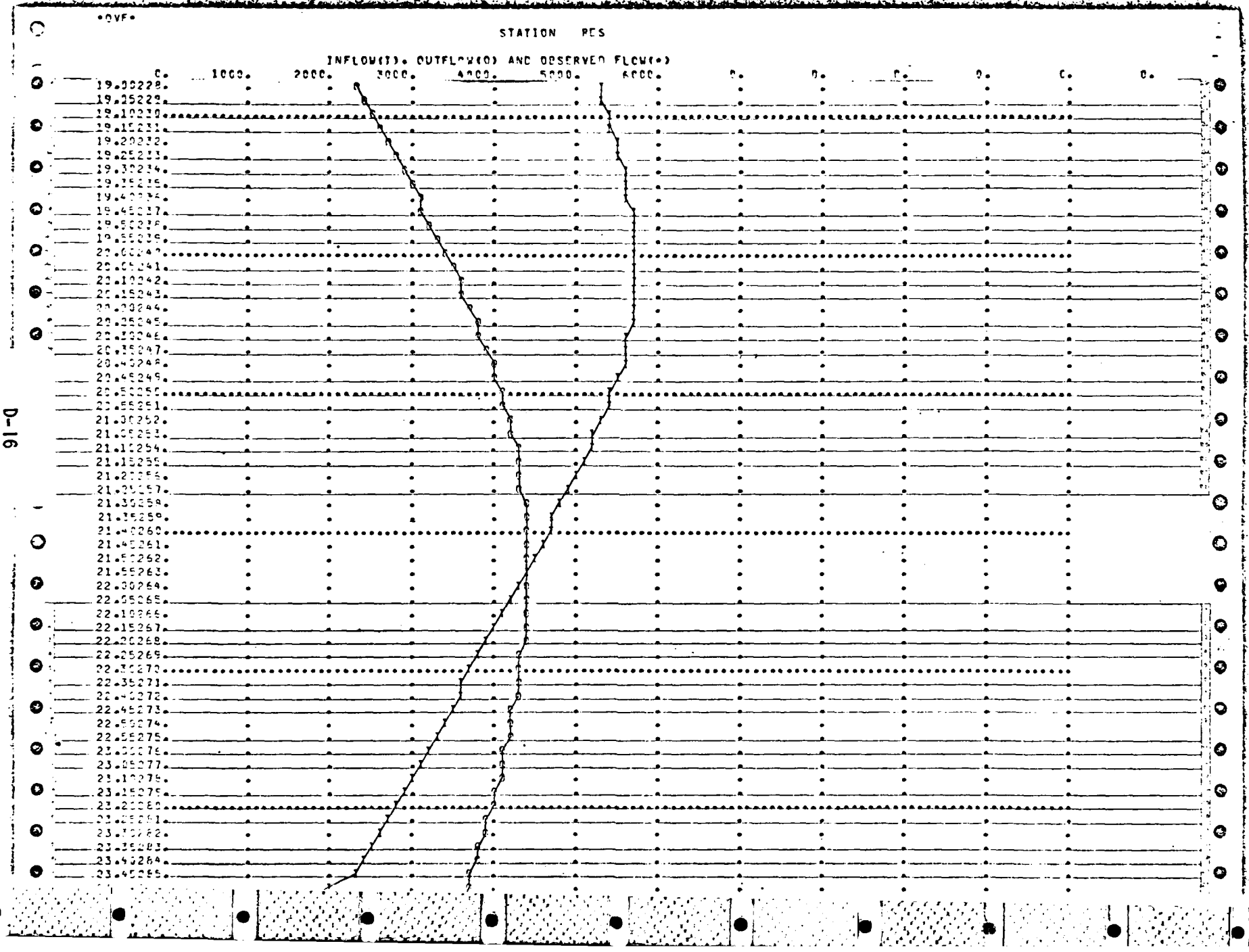
FLOW	0.00	87.00	239.00	811.00	1610.00	2613.00	3853.00	5300.00	6813.00
	10882.00								
SURFACE AREA=	1.	20.	52.	101.	204.	384.			
CAPACITY=	0.	43.	215.	590.	1338.	7707.			
ELEVATION=	1338.	1343.	1348.	1353.	1358.	1380.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1358.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID.
1365.0	3.1	1.5	132.

PEAK OUTFLOW IS 4407. AT TIME 21.92 HOURS


OVF
STATION RES
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 1000. 2000. 3000. 4000. 5000. 6000. 0. 0. 0. 0. 0. 0.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1
				0.50
HYDROGRAPH AT	SA-1	0.66	1	5709.
		(25.01)		(161.67)(
HYDROGRAPH AT	SA-RES	0.32	1	2216.
		(0.83)		(62.75)(
2 COMBINED	SA-2C	0.98	1	5724.
		(25.84)		(162.08)(
ROUTED TO	RES	0.98	1	4407.
		(25.84)		(124.79)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1359.00	1358.00	1365.00
STORAGE	1338.	1338.	2942.
OUTFLOW	0.	0.	5300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1364.38	0.00	2786.	4407.	0.00	21.92	0.00

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Phone 665-2161

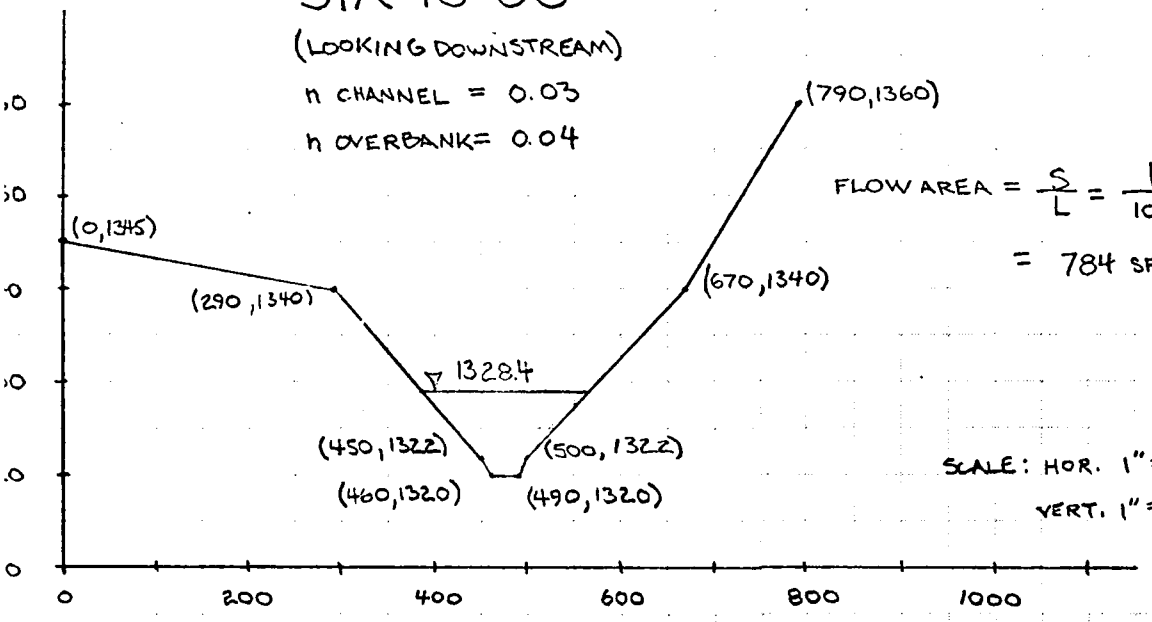
JOB GALE MEADOWS DAM
SHEET NO. ____ OF ____
CALCULATED BY ELV DATE 2/7/80
CHECKED BY [illegible] DATE 10/9/80
SCALE 21-06-79109

STA 10+00

(LOOKING DOWNSTREAM)

n CHANNEL = 0.03

n OVERBANK = 0.04



FLOW AREA = $\frac{S}{L} = \frac{18}{1000} \times 43560$

= 784 SF

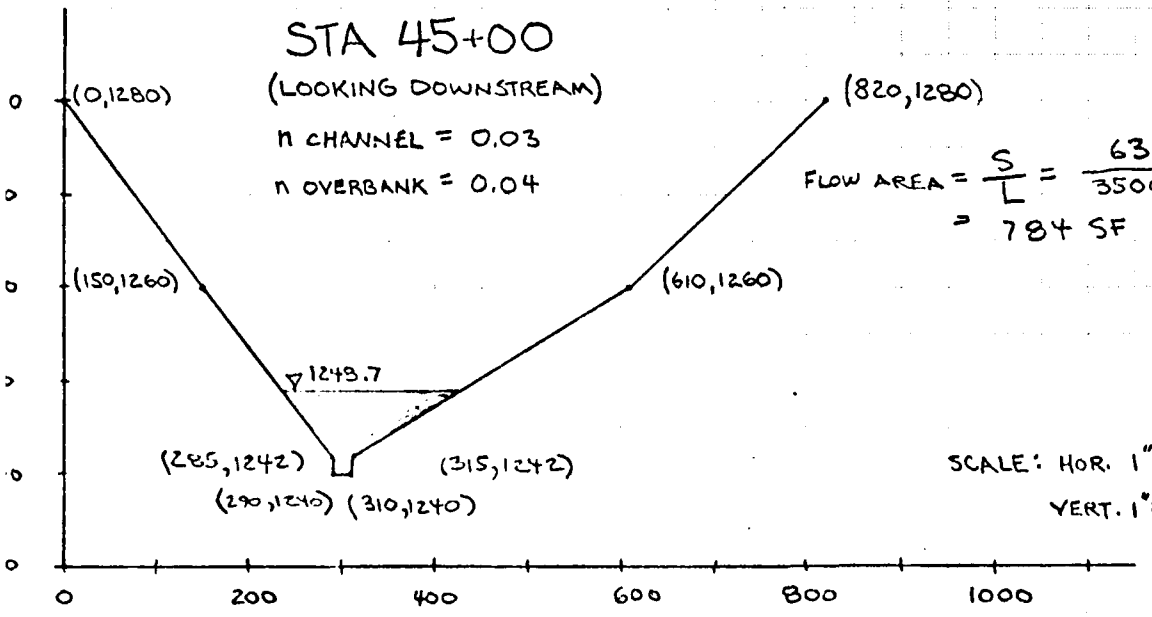
SCALE: HOR. 1" = 200'
VERT. 1" = 20'

STA 45+00

(LOOKING DOWNSTREAM)

n CHANNEL = 0.03

n OVERBANK = 0.04



FLOW AREA = $\frac{S}{L} = \frac{63}{3500} \times 43560$

= 784 SF

SCALE: HOR. 1" = 200'
VERT. 1" = 20'

REFERENCES

This is a general list of references pertinent to dam safety investigations. Not all references listed have necessarily been used in this specific report.

1. "Recommended Guidelines For Safety Inspection of Dams", Appendix D of ER 1110-2-106, Dept. of the Army, Office of the Chief of Engineers, Washington, D.C., 26 September 1979.

2. "HEC-1 Flood Hydrograph Package, Users Manual", The Hydrologic Engineering Center, U.S. Army Corps of Engineers, January 1973.

3. "Flood Hydrograph Package (HEC-1), Users Manual for Dam Safety Investigations", The Hydrologic Engineering Center, U.S. Army Corps of Engineers, September 1978.

4. HMR 33, "Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations from 6 to 48 Hours," U.S. Department of Commerce, NOAA, National Weather Service, 1956.

5. HMR 51, "All-Season Probable Maximum Precipitation, U.S. East of 105th Meridian for Areas from 1000 to 20,000 Square Miles and Durations from 6 to 72 Hours", U.S. Department of Commerce, NOAA, National Weather Service, 1974.

6. HYDRO-35, "Five-to-60 Minute Precipitation Frequency for the Eastern and Central United States", U.S. Department of Commerce, NOAA, National Weather Service, June 1977.

7. "Technical Paper No. 40, Rainfall Frequency Atlas of the United States", U.S. Department of Commerce, Weather Bureau, 1961.

8. Design of Small Dams, United States Department of the Interior, Bureau of Reclamation, Second Edition, 1973.

9. King, Horace W. and Brater, Ernest F., Handbook of Hydraulics, fifth edition, McGraw-Hill Book Co., Inc., New York, 1963.

10. "Flood Hydrograph Analyses and Computations", EM 1110-2-1405, U.S. Army Corps of Engineers, 31 August 1959.

11. "Technical Release No. 55, Urban Hydrology for Small Watersheds", U.S. Department of Agriculture, Soil Conservation Service (Engineering Division), January 1975.

APPENDIX F

REFERENCES

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

THIS SHEET TO BE FURNISHED BY

THE CORPS OF ENGINEERS

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1365.00	1358.00	1365.00
STORAGE	2942.	1338.	2942.
OUTFLOW	5300.	0.	5300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1364.94	0.00	2942.	14678.	0.00	1.87	0.00

PLAN 1 STATION 10+00

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	14683.	1328.4	1.87

PLAN 1 STATION 45+00

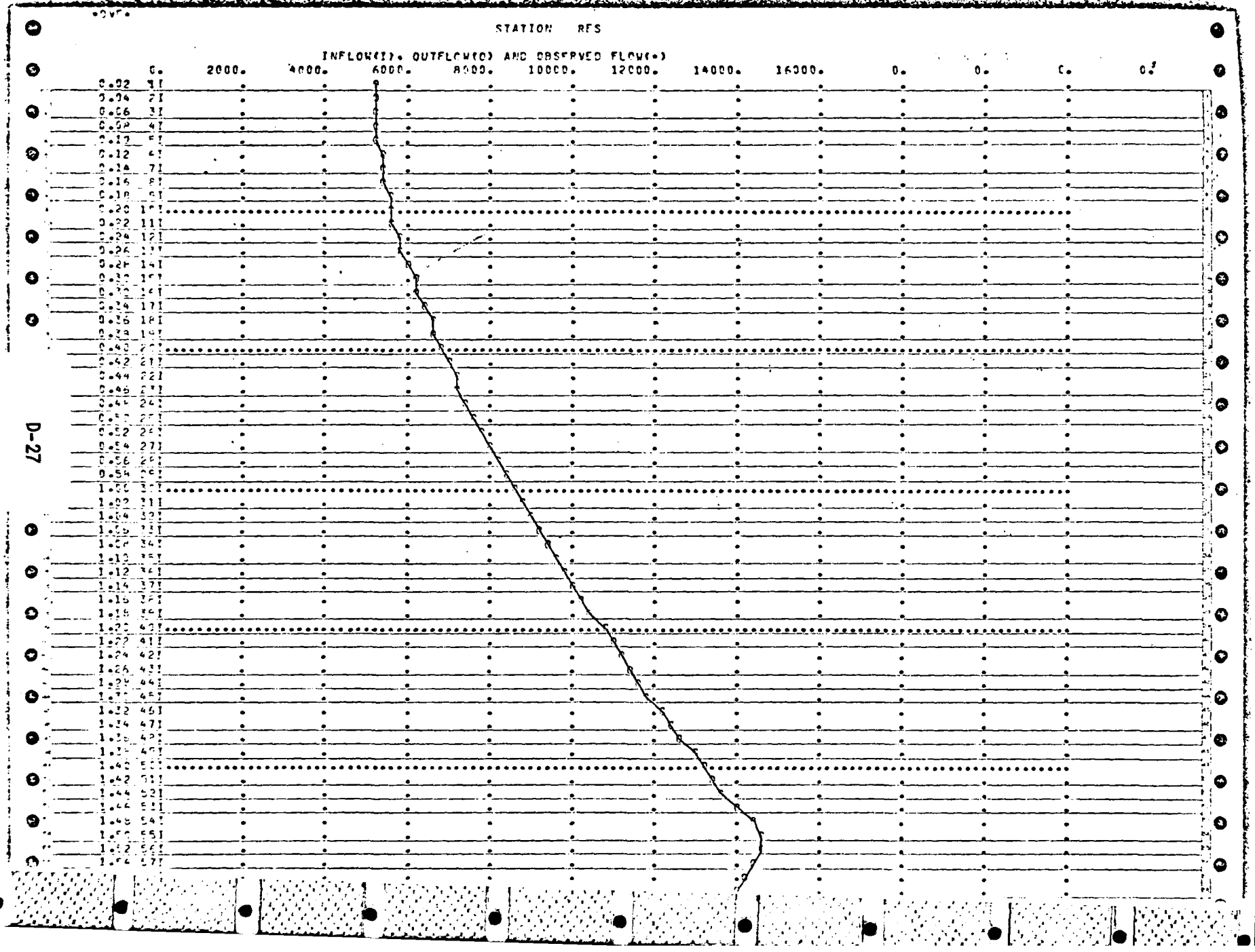
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	14508.	1248.7	1.90

PLAN 1 STATION 85+00

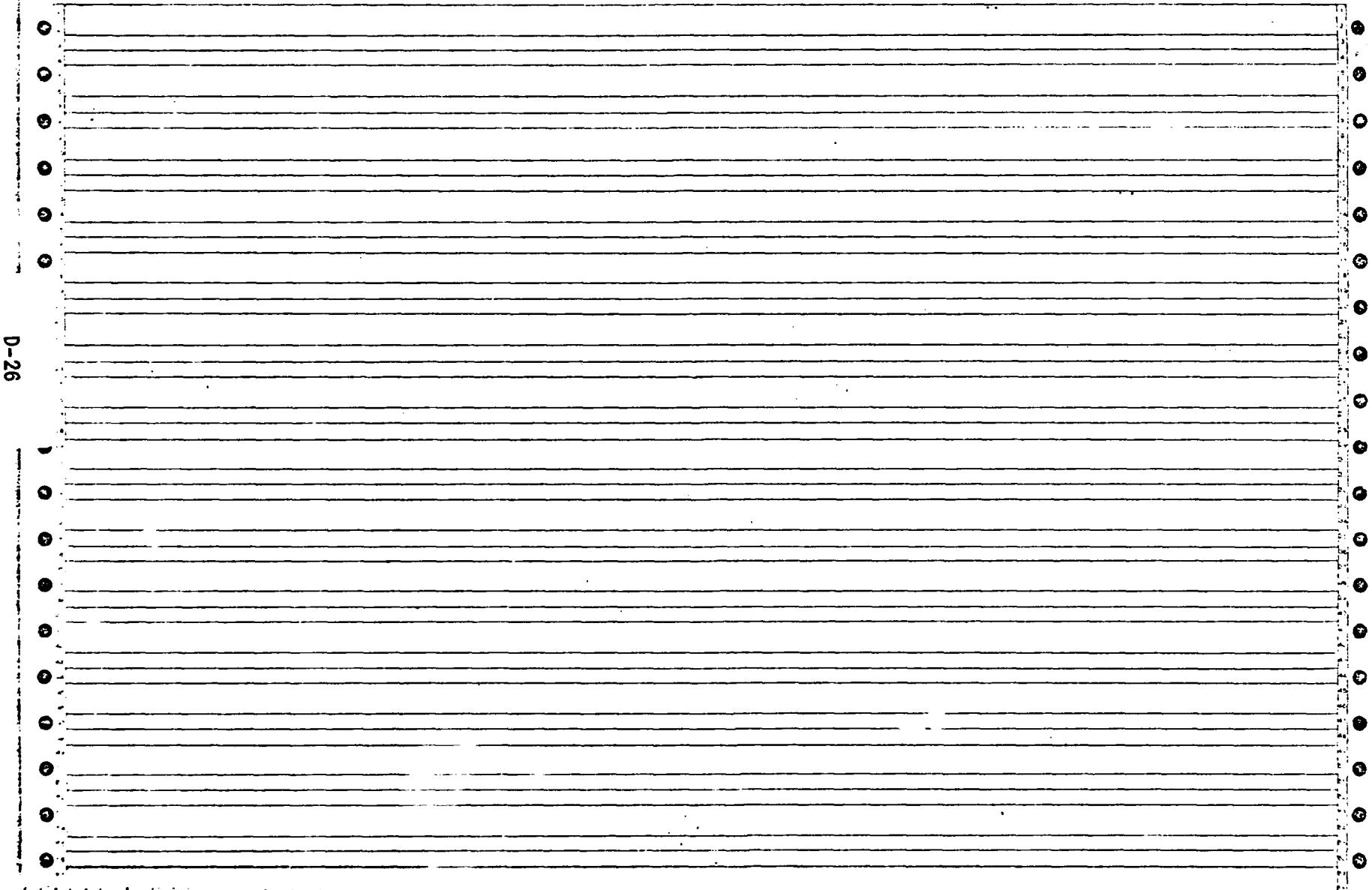
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	14386.	1127.8	1.93

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	SA-RES	0.32 (0.83)	1	0. (0.00)(
ROUTED TO	RES	0.32 (0.83)	1	14678. (415.62)(
ROUTED TO	10+00	0.32 (0.83)	1	14683. (415.77)(
ROUTED TO	45+00	0.32 (0.83)	1	14509. (410.82)(
ROUTED TO	85+00	0.32 (0.83)	1	14386. (407.38)(


STATION RES
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. 16000. 0. 0. 0. 0.

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF 0.033 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF 0.033 HOURS.
THE TIME INTERVAL FOR BREACH DEVELOPMENT AND DOWNSTREAM ROUTING ARE THE SAME.



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A NED DAM INSPECTION CONTRACT: DACW-80-C-0012 GMDP1
A VT. 00115 GALE MEADOWS DAM, 21-06-79109
A BREACH AT TOP OF DAM
B     60       0       2                                                     4
B1     5
J      1       1       1
J1   1.0
K      0  SA-RES                        1                 1
K1 SUBAREA RESERVOIR RUNOFF
M      1      -1   0.319                                                     1
P
T
U      1
U1
X      0       0       1
K      1     RES                        2        1        1
K1 ROUTING FLOWS THROUGH RESERVOIR
Y                              1        1
Y1     1                                              -1365       -1
Y4  1358    1359    1360    1361     1362     1363     1364     1365     1366     1367
Y4  1368
Y5     0      87     239     811     1610     2613     3853     5300     6813     8859
Y5 10882
$A   1.2    19.6    51.8   101.1    204.0    384.4
$E  1338    1343    1348    1353     1358     1380
$$  1365
$D  1365   3.087     1.5   131.5
$B    40     2.5    1338    1.85     1365     1365
K      1   10+00                                 3        1
K1 CHANNEL ROUTING STA 10+00
Y                              1        1
Y1     1
Y6   .04     .03     .04    1320     1339     1000     .018
Y7     0    1345     250    1340      450     1322      460     1320      490     1320
Y7   500    1322     670    1340      790     1360
K      1   45+00                                 3        1
K1 CHANNEL ROUTING STA 45+00
Y                              1        1
Y1     1
Y6   .04     .03     .04    1240     1259     3500     .023
Y7     0    1260     150    1260      285     1242      290     1240      310     1240
Y7   315    1242     610    1260      820     1280
K      1   85+00                                 3        1
K1 CHANNEL ROUTING STA 85+00
Y                              1        1
Y1     1
Y6   .04     .03     .04    1120     1139     4000      .03
Y7     0    1140     140    1140      285     1122      290     1120      320     1120
Y7   325    1122     560    1140     1050     1160
K     99
A
A
A
A
A
```

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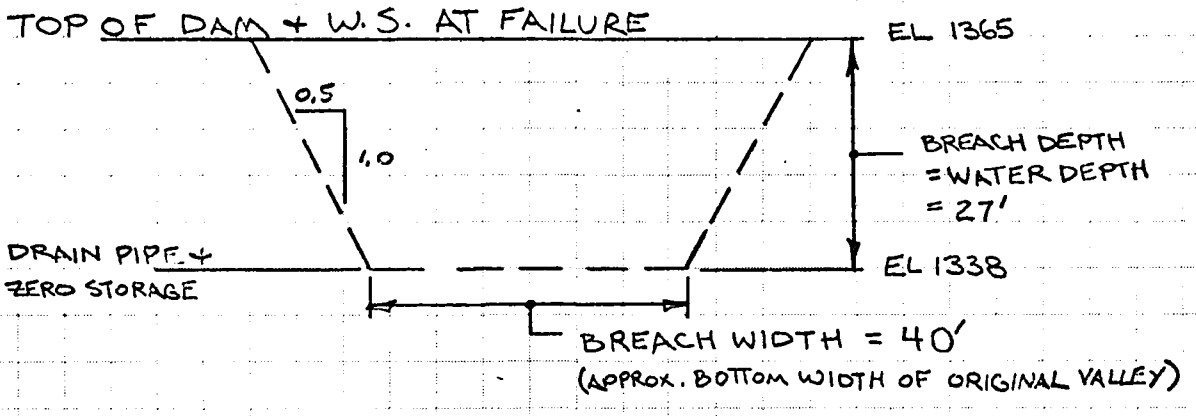
JOB GALE MEADOWS DAM
SHEET NO. _____ OF _____
CALCULATED BY ELV DATE 9-10-80
CHECKED BY GPR DATE 10/9/80
SCALE 21-06-79109

BREACH CRITERIA

EARTH DAM



RULE OF THUMB PEAK OUTFLOW - SUDDEN BREACH

$Q = \frac{8}{27} w_b \sqrt{g}\, y_o^{1.5}$

$Q = 9{,}435$ cfs

w_b = BREACH WIDTH = 40'

y_o = WATER DEPTH = 27'

ADDITIONAL FLOW (BREACH SEPARATE FROM SPILLWAY)

TOTAL PROJECT DISCHARGE @ TOP OF DAM 5,300 cfs
LESS ANY DIVERSION FLOW 0 cfs
5,300 cfs

TOTAL PEAK OUTFLOW FROM DAM

$Q_p = 9435$ cfs $+ 5300$ cfs $= 14{,}735$ cfs SAY **14,700 cfs**

HEC-1 DB BREACH PROGRAM

CALCULATION INTERVAL = 2 MINUTES

BREACH TIME (hr)		PEAK OUTFLOW (cfs)
2		14,400
1.6		15,600
1.85 hr.	USE	14,700

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1365.00	1358.00	1365.00
STORAGE	2942.	1338.	2942.
OUTFLOW	5300.	0.	5300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1365.00	0.00	2942.	5300.	0.00	0.00	0.00

PLAN 1 STATION 10+00

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	5300.	1325.2	0.02

PLAN 1 STATION 45+00

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	5300.	1245.8	0.02

PLAN 1 STATION 85+00

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	5300.	1125.0	0.02

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	SA-RES	0.32 (0.83)	1	5300. (150.08)
ROUTED TO	RES	0.32 (0.83)	1	5300. (150.08)
ROUTED TO	10+00	0.32 (0.83)	1	5300. (150.08)
ROUTED TO	45+00	0.32 (0.83)	1	5300. (150.08)
ROUTED TO	85+00	0.32 (0.83)	1	5300. (150.08)

```
A NED DAM INSPECTION CONTRACT: DACW-80-C-0012 GMPF1
A VT. 00115 GALE MEADOWS DAM. 21-06-79109
A PRIOR FLOW AT TOP OF DAM
B     10         0         1                                                   4
B1     5
J      1         1         1
J1   1.0
K      0  SA-RES                       1                   1
K1 SUBAREA RESERVOIR RUNOFF
M      1        -1     0.310                                                   1
P
T
U      1
U1
X   5300         0         1
K      1       RES                     2         1         1
K1 ROUTING FLOWS THROUGH RESERVOIR
Y                            1         1
Y1     1                                               -1365        -1
Y4  1358      1359      1360      1361      1362      1363      1364      1365      1366      1367
Y4  1368
Y5     0        87       239       811      1610      2613      3853      5300      6813      9059
Y5 10482
$A   1.0      19.6      51.8     101.1     204.0     384.4
$E  1338      1343      1348      1353      1358      1380
$$  1358
$D  1345     3.087       1.5     131.5
K      1     10+00                                   3         1
K1 CHANNEL ROUTING STA 10+00
Y                            1         1
Y1     1                                                  -1
Y6   .04       .03       .04      1320      1339      1000      .018
Y7     0      1345       250      1340       450      1322       460      1320       450      1320
Y7   500      1322       670      1340       790      1360
K      1     45+00                                   3         1
K1 CHANNEL ROUTING STA 45+00
Y                            1         1
Y1     1                                                  -1
Y6   .04       .03       .04      1240      1259      3500      .023
Y7     0      1260       150      1260       285      1242       290      1240       310      1240
Y7   315      1242       610      1260       820      1280
K      1     85+00                                   3         1
K1 CHANNEL ROUTING STA 85+00
Y                            1         1
Y1     1                                                  -1
Y6   .04       .03       .04      1120      1139      4000       .03
Y7     0      1160       140      1140       285      1122       290      1120       320      1120
Y7   325      1122       560      1140      1050      1160
K     99
A
A
A
A
A
```

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Phone 665-2161

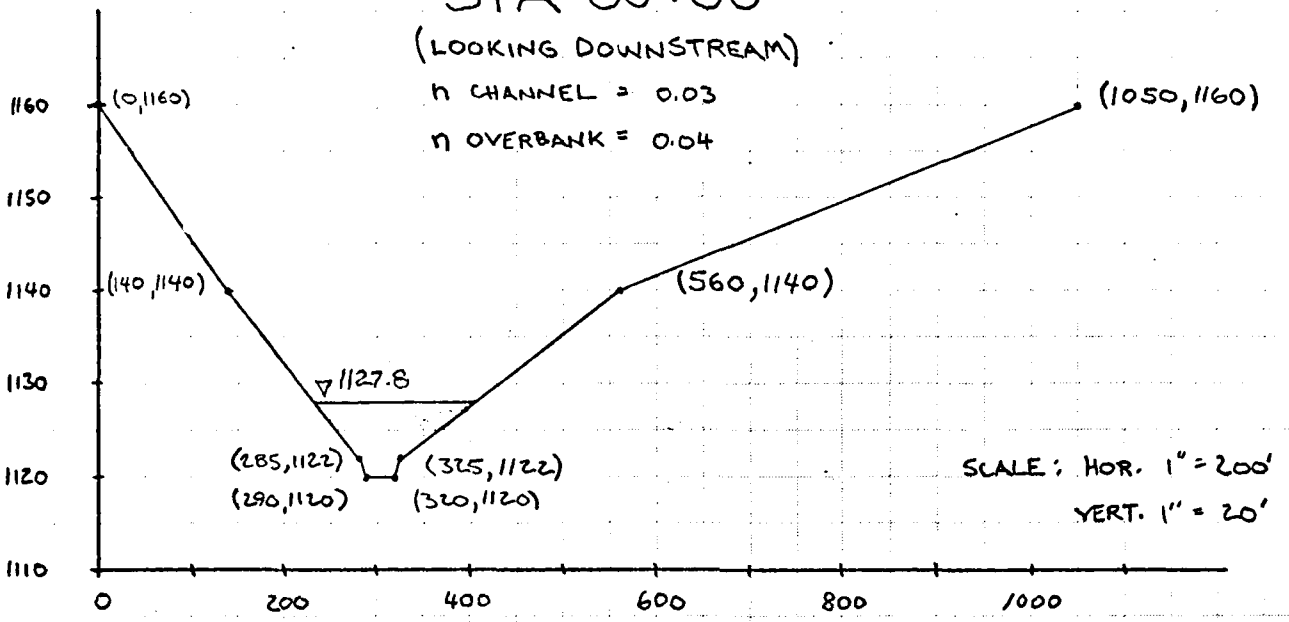
JOB GALE MEADOWS DAM
SHEET NO. ____ OF ____
CALCULATED BY ELV DATE 2/7/80
CHECKED BY [illegible] DATE 10/9/80
SCALE 21-06-79109

STA 85+00

(LOOKING DOWNSTREAM)

n CHANNEL = 0.03

n OVERBANK = 0.04



$$\text{FLOW AREA} = \frac{S}{L} = \frac{60}{4000} \times 43{,}560$$

" = 653 SF

12. "Hydraulic Design of Spillways", EM 1110-2-1603, U.S. Army Corps of Engineers, 31 March 1965.

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14. "Hydrologic and Hydraulic Assessment", Appendix D of EC 1110-2-188, U.S. Army Corps of Engineers, 30 December 1977.

15. "Reviews of Spillway Adequacy, National Program of Inspection of Non-Federal Dams", ETL 1110-2-234, U.S. Army Corps of Engineers, 10 May 1978.

16. Hammer, Mark J., Water and Waste-Water Technology, John Wiley & Sons, Inc., New York, 1975.

17. "Hydraulic Charts For the Selection of Highway Culverts", Hydraulic Engineering Circular No. 5, U.S. Department of Commerce, Bureau of Public Roads, December 1965.

18. 33 CFR Part 22, Final Rule, "Engineering and Design; National Program For Inspection of Non-Federal Dams", ER 1110-2-106, U.S. Army Corps of Engineers, March 24, 1980.

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20. "Climatological Data - May 1979 - New England", Volume 91, No. 5, National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina.

21. "Climatological Data - Annual Summary - New England", Volume 90, No. 13, National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina.

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